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Getting the Most Out of Your Machine Tool Dollar

By M. H. Westbrook

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THE railroad shop executive is confronted with many problems in connection with the question of getting the most from his machine tool dollar. Some of these problems are quite different from those that have to be met and solved by manufacturers of commodities. Sometimes, too, it isn't so much of a problem how to spend his machine tool dollar as it is to get the dollar to spend.

This is true to a much greater extent than in other large industries, and with reason when we consider the different factors involved. In the manufacturing industries, machine tools are vital because without them there would be no product to sell. In railroad work there is no product to be sold, and the machine tools used are merely to keep the locomotives and cars in running order. Even large manufacturers are not as keen in buying the latest machine tools for their maintenance departments as they are for the production shop that produces dividends directly. But the situation is improving on nearly all railroads, and new machine tools are forthcoming in most cases when a good reason can be shown for their purchase, and the budget has a few dollars left in the treasury.

There are two primary reasons for buying new machine tools equipment. The first and most urgent is when the old machine breaks down to such an extent as to be useless, or goes out of commission so frequently as to be undependable. The second and less urgent, though not perhaps less important reason, is the saving of cost in making repairs. And this reason has two phases. For while the actual saving in labor on the machining of the work might not warrant the purchase of a new machine it frequently happens that enough idle time of the locomotives can be saved to make it a good investment.

This phase of the problem of locomotive maintenance is one that does not receive sufficient attention. The earnings of a locomotive in service are great enough to make it profitable to expedite repairs, even though the actual saving on labor may not seem to warrant the investment in a new machine tool.

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Just one instance to illustrate. Most any older railroad man can recall when it took ten to eighteen hours to turn a pair of locomotive tires. The writer well remembers a shop operating five tire-turning lathes, some of them night and day, where one modern tire lathe is now doing all the tire work necessary, although the business of that particular road has doubled.

The introduction of high-speed steel reduced the turning time by one-half, first. Then a few years later, a modern wheel lathe did the rest. A set of three pairs of wheels can be removed, tire turned and engine rewheeled the same day under present conditions.

Much criticism has been leveled at railroad shops by those who do not appreciate that their problems differ from those in a manufacturing plant. Instead of being able to run work through the shop in good-sized lots, the great majority of the work is done in ones and twos. Machine tools have to be selected so as to handle a variety of work with fair efficiency rather than a good-sized lot at a higher rate of production. The appropriations for machine tools have to be handled so as to secure the best returns possible, under what the production man in a large shop would consider adverse conditions.

Another phase that the railroad-shop manager must consider, perhaps even more carefully than in the case of the production shop, is the kind of operator for the machines. Where jobs are changed frequently, the question of setting-up becomes most important, and a few minutes saved in set-up reduces the cost of the work considerably. With an operator who is interested in his machine and his job, there are many ways of saving time and money that the average time-study man or planner knows little or nothing about. Get a

man's co-operation and you get more production, even under the adverse conditions of small runs, than is possible in any other way.

The old idea of forcing a man to use the machine you pick out, whether he likes it or not, may bolster up your idea of authority and dignity, but it never increases production and you never get the benefit of the ideas that crop up from time to time. If, of course, the only ideas worth while came from the planning department, as Mr. Taylor used to think, this might not matter, but we who handle work and workmen under modern conditions, know that the man on the job has many ideas that are valuable, and we want them.

Getting Approval from the Shop

Long before we come to the point, where we can order a new machine for the shop, we are pretty well convinced as to the type best suited to our work. But instead of deciding on the machine in the office, we insure a welcome for it out in the shop long before the order is placed, by paving the way for its favorable reception.

Both for general information and to familiarize the men with the machines to be purchased, we send the foreman, and frequently the men who are to operate the new machines, to one or two shops where these machines are in use. We ask them to look them over, ask the men who run them how they like them and how they perform, and make us a report on the machine or machines in question.

In this way the men get an idea as to how the machines are performing in other shops, get a line on what the other men think of them, and absorb more or less general knowledge at the same time. They usually come back with enthusiastic reports as to the machine and anxious to have one for our own shop. If they do not, but have objections to offer, or suggestions as to some other machines, we look into the objections and frequently find them well founded. Unless we can show that the unfavorable impression made was due to unusual conditions or to poor operations, we cross the machine off the list without further argument. When the foreman and the operator feel that a machine is not the best in its field, it is useless to hope for best results from its operation.

Unless the machine is "sold" to the men who are to control it, there is not the same chance of its being as much of a success as there should be to pay for its installation. But when the men ask for a machine, after having seen it perform elsewhere, there is every reason to believe that it will succeed. Having recommended a machine and having the recommendation adopted, puts it up to the shop to make it succeed—and it generally does. For every man likes to feel that he is really part of an organization, and that his opinions carry weight with those in authority. Having secured the new machine through the recommendation of the department of the shop in which it is to be used, the next thing is to make it show a saving in proportion to its cost.

Before asking for a new machine, we estimate the saving to be secured and if we can feel sure of a reduction of 15 per cent in the cost of work, we consider the purchase justified. This means that the new machine should pay for itself in between six and seven years, which we think is a fair basis, even though many machine tools in a railroad shop last from fifteen to twenty years with good care.

The writer even knows of a Sellers 48-in. x 18-ft. planer, that was exhibited at the Centennial Exhibition at Philadelphia in 1876 which has been in constant service ever since, sometimes twenty-four hours a day, in a well-known, modern, railway shop.

If it happens to be a machine that is needed to keep work going through the shop, it may be a good investment even if it shows no direct saving. And, as before mentioned, the new machine may well pay for itself if it helps to get the engines into service sooner, even though it saves no money on the operation itself.

As a result of this policy, and the new equipment that has been added to this shop, the larger locomotives of the present day are being repaired at a lower cost than the older and smaller locomotives of ten years ago. This is particularly gratifying since the railroad-shop strike disorganized some shops to such an extent that it took a long time to get costs down to even the previous basis. This shop has been fortunate in securing the complete co-operation of its men, who take pride in the performance of the machine equipment and in the cost records. And though stop watches are taboo in many railway shops, the men here seem to welcome the opportunity of showing that they can get as much out of a machine as anyone else. This state of mind also reflects to the credit of the management, since it indicates, very clearly, complete confidence in the fairness of those in charge of the shop.

Much Depends on the Operator

Getting the most out of the machine tool dollar depends on more than picking the right machine and buying it at a particular price. It depends on getting the machine tool into the hands of an operator who, as well as the foreman, wants it to succeed and who has a real interest in its performance. And this is just as important a phase of management as the selection and purchase of the machine tool itself.

Of course, I quite appreciate that this will, no doubt, grate upon the sensibilities and ruffle the dignity of those who think that all the required knowledge of machinery, purchase and operation, rests with their master minds. But happily this type of manager is fast getting into step with the modern trend of obtaining the fullest co-operation between all craftsmen and helpers, the foremen and the management.

[The preceding article is the fourteenth under the title, "Getting the Most Out of Your Machine Tool Dollar." The first article, by J. A. Smith, General Superintendent of the General Electric Co., Schenectady, N. Y., was published on page 409, Vol. 62. The second, by C. A. Shaffer, General Supervisor of Machinery and Tools of the Illinois Central Railroad, was published on page 521, Vol. 62. The third, by Robert F. Runge, Vice-president of SKF Industries, Inc., was published on page 719, Vol. 62. The fourth, by L. C. Morrow, Managing Editor, *American Machinist*, outlining the policies of the International Harvester Co., was published on page 793, Vol. 62. The fifth, by G. T. Christopher, Factory Manager, the Dayton Engineering Laboratories Co., was published on page 907, Vol. 62. The sixth, by D. C. Wright, of the H. W. Caldwell & Son Co. plant of the Link-Belt Co., was published on page 1, Vol. 63. The seventh, by T. C. Vail, superintendent, the Spicer Manufacturing Co., was published on page 175, Vol. 63. The eighth, by E. R. Norris, director of works equipment, the Westinghouse Electric and Manufacturing Co., was published on page 255, Vol. 63. The ninth, by Fred H. Colvin, Editor, *American Machinist*, was published on page 417, Vol. 63. The tenth, by Wm. Bailey, production manager, the Hoover Co., was published on page 917, Vol. 63. The eleventh, by G. S. McKee, assistant factory manager, the Timken Roller Bearing Co., was published on page 995, Vol. 63. The twelfth, by Wm. Hartman, was published on page 1, Vol. 64. The thirteenth, by Percy S. Brown, works manager, the Corona Typewriter Co., Inc., was published on page 183, Vol. 64. Other articles on the same subject will be published in forthcoming issues.]

Samuel Vauclain says: "We owe our present prosperity to high wages. If wages were suddenly cut in half, which fortunately cannot be done, we should experience the worst panic in history."

Automotive Production

Willys-Knight Production Methods

By Fred H. Colvin
Editor, *American Machinist*

Roughing out eccentric shafts on a gear hobber with eccentric milling cutters—Finish turning all throws at once on special lathe

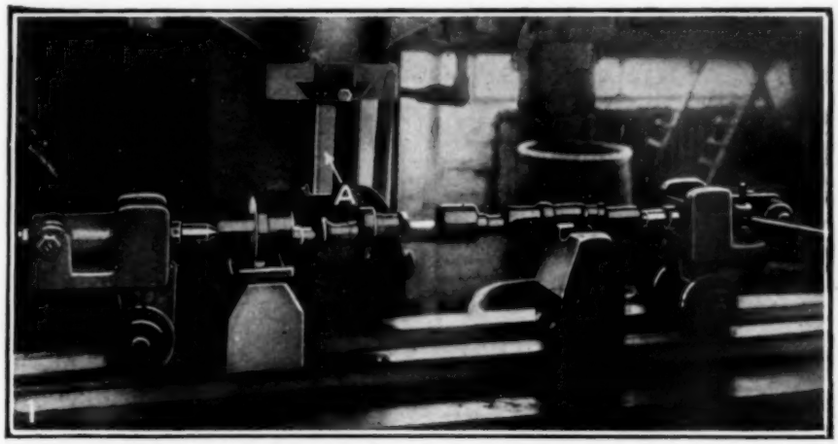
Eccentric Shafts and Sleeve Rods

INSTEAD of a cam shaft and valve lifters, the Knight engine has an eccentric shaft and small connecting rods which together actuate the two sleeves in each cylinder. And while the eccentric shaft is similar to a cam shaft, it presents somewhat different problems in its manufacture, as will be seen. After inspection and rough centering, the shaft is straightened under a Metalwood hydraulic press, as in Fig. 1, which shows the centers on movable-wheeled carriages, and the supports that take the thrust of the pressure. These supports are also mounted on rollers but seat solidly when pressure is applied. In this way the shaft can be straightened at any point, the pressure being applied by the ram *A*.

The center bearing is snagged, if necessary, and is then turned on the American lathe, Fig. 2. This view shows how the follower backrest is fastened to the top of the toolpost, and how it can be lifted out of the way by releasing the handle at *A*. The shaft is then milled to length on the double-headed Moline machine shown in Fig. 3, the shaft being clamped at each end, close to the cut. Each chuck is independent but both are mounted on the same base and are moved across the bed with the table. The shaft is then recentered and is ready for the next operation. This method is an example of the growing use of milling machines for such work.

The flange, the other bearings and the ends of the shaft are then turned, and a keyway cut for a No. 11 Woodruff key, which is inserted and goes with the shaft to insure its proper location in the future machining operations.

After a rough grinding of the shaft bearings as in Fig. 4, the crank throws are machined by the ingenious method shown in Fig. 5 on a Gould & Eberhardt gear hobbing machine, four throws being cut at once. The shaft is positioned by the keyway. The four milling cutters are mounted eccentrically on the arbor and the arbor and the shaft to be machined are so geared together that the cutters follow the throw of the cranks as they revolve. The operation is unusual and rough



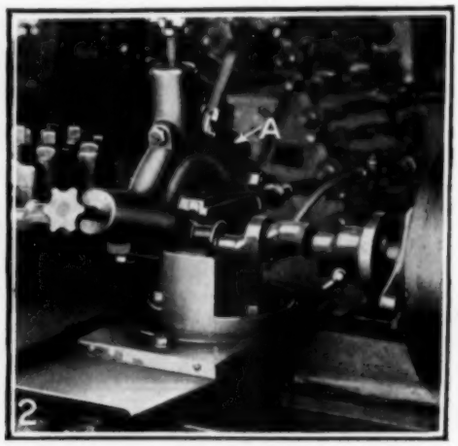


Fig. 1—Straightening eccentric shaft. Fig. 2—Turning center bearing and flange

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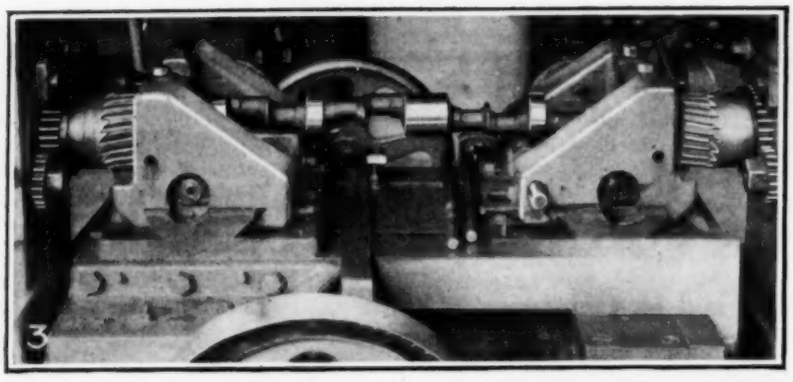

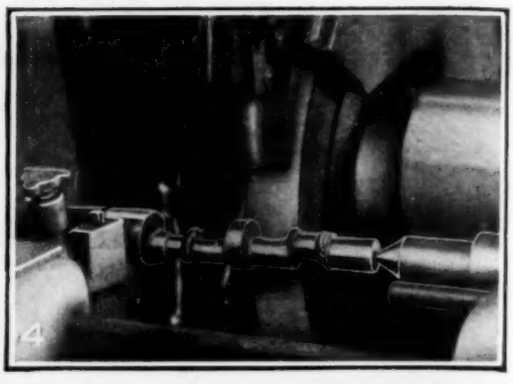

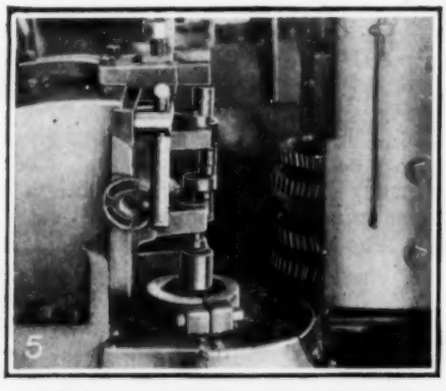

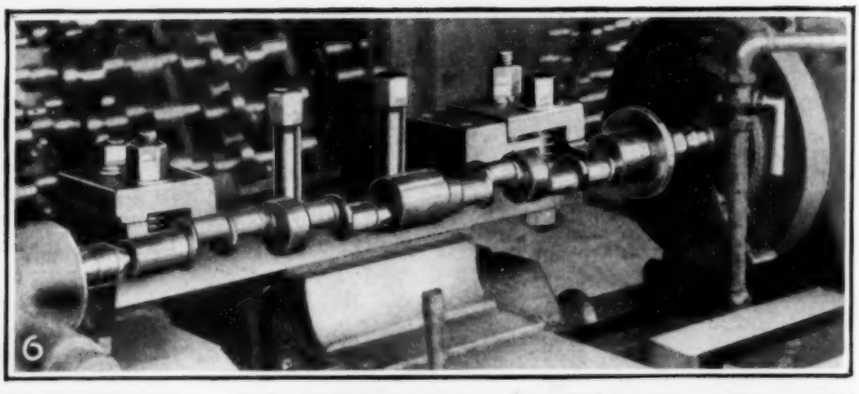

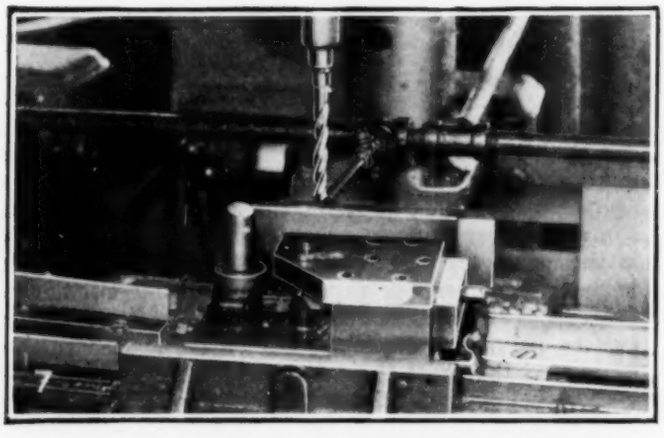

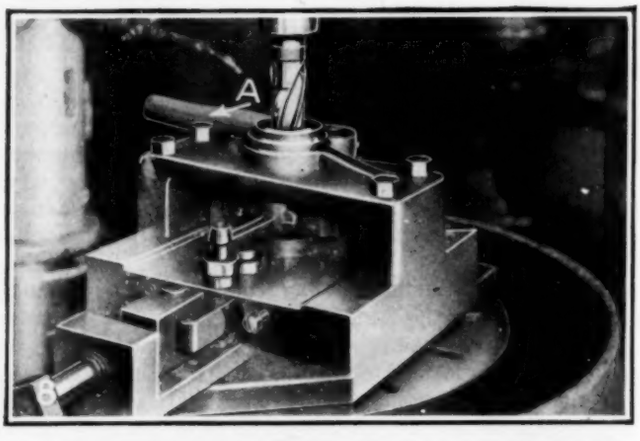

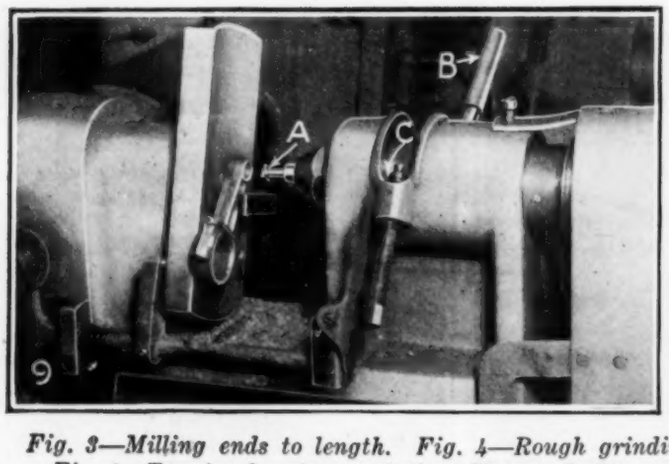

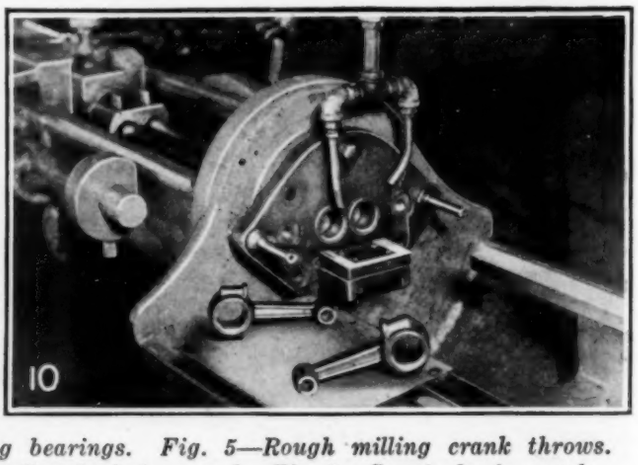

Fig. 3—Milling ends to length. Fig. 4—Rough grinding bearings. Fig. 5—Rough milling crank throws. Fig. 6—Turning bearings on lathe. Fig. 7—Drilling small end of sleeve rod. Fig. 8—Counterboring oval end of rod. Fig. 9—Milling groove for retaining ring. Fig. 10—Broaching rods from the rough

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mills the surfaces of the pins at a rapid rate. Then the shaft is raised and the other four throws milled in the same way.

The throws are then returned on a Melling cam lathe after which the shaft is again straightened if necessary. A special toolblock for finish turning the end bearings and facing the flange is shown in Fig. 6, the method of holding the tools on the same type of lathe as in Fig. 2, being of special interest.

The various throws are then ground, the shaft is again inspected and straightened, recentered, the main bearings again ground as well as the flange and collar. The timing line is marked and the flange is drilled, chamfered, tapped and burred, and after a final inspection the shaft is ready for assembly. The eccentric shaft for the 4-cylinder engine only, has been shown. The line-up for the 6-cylinder shaft includes Lo-Swing lathes in the turning operation but many of the operations are similar.

The sleeve rods are short connecting rods. There are two lengths of sleeve rods, one each for the inner and outer sleeves. While similar in most ways to connecting rods, they have a few distinctive operations. The rods are forgings, and after straightening, are drilled at the small end with a $\frac{7}{16}$-in. drill. The large hole is punched in the forging and serves as a locating point for the first drilling. The hole in the small end is drilled as in Fig. 7. A beveled jaw operated by a screw, forces the end of the rod down on the fixture and against the plug through the large end. Ample provision is made for lubricant.

The ends of the large hole are then counterbored or chamfered as in Fig. 8. The fixture is special because the hole is not round, but oval, and the lever *A* at the back shifts the work from one position to the other, so that the whole contour is chamfered.

One of the unusual operations is the milling of a ring groove in the center of the small hole in the end of the rod. This groove serves the double purpose of holding a spring-retaining ring by which the pin is held in position, and also as a means of oiling the pin by an oil hole through the end. The way in which the groove is milled is shown in Fig. 9. The rod is clamped on a suitable plate and the small milling cutter *A*, advanced to the center of the rod, being located by a suitable stop. The cutter is mounted in an eccentric sleeve that permits it to enter the hole and then to be brought into cutting position and moved to the required depth, by the handle *B*. The depth of cut is determined by the stop-screw *C*. The head on which the rod is mounted also revolves, and one revolution completes the operation.

The hole is reamed to remove the burr thrown up by the cutter, and a hole drilled into the groove and countersunk. Then the hole in the large end of the rod is broached from the rough forging, an unusual operation. Two rods are broached at once on the double LaPointe broaching machine shown in Fig. 10. The rods are located by the small end on the pins shown at each end of the fixture.

It will be noted that the broached holes are not round but oblong, with flattened sides. The broached surface

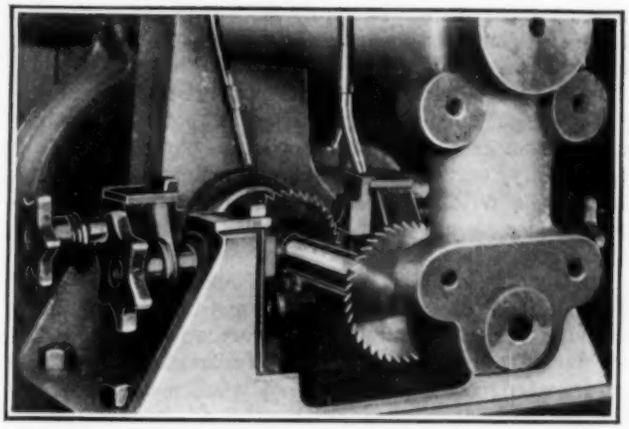

Fig. 11—Cutting off the caps

is to hold the babbitt bearing metal and no further finish is necessary. Babbitting comes next, the centrifugal method being used for this purpose; after which the stud holes are drilled in the ears of the rod. These drills are $\frac{1}{4}$ in. and $\frac{7}{16}$ in. respectively, and the holes are tapped for the studs.

The rods are then cut to remove the caps as in Fig. 11, the fixture holding four rods, two of which are operated on at the same time by the two saws shown on the arbor. The other half of the fixture is loaded during the cut, so that the operation is nearly continuous. The rods are quickly clamped in position and the operation is very rapid. The oblong hole assures an even amount of babbitt around the pin after the cap has been cut off.

With the cap assembled in position, the babbitt is bored, faced and countersunk on both sides. Oil holes are drilled and countersunk, and the bearing finished to 0.873 in. After burring and inspection the rod is ready for assembly.

Welding—Discussion

By E. Andrews

THE abstract under the title given above and published on page 327, Vol. 63, of the *American Machinist*, was of interest to me because I have had considerable experience in the art of repairing a variety of damaged, broken and worn automobile parts. I should like therefore, to add a few further notes on the progress made during recent years in the motor repair shop by the practical application of the oxyacetylene welding torch.

Autogenous welding with the oxyacetylene torch has long since passed the experimental stage and has come to have a permanent standing in the motor repair shop, notwithstanding the statement sometimes made that "The autogenous welding process is still in its infancy." This quotation and similar ones, I think, are somewhat misleading, especially after observing that 58 pages of practical information, drawn from more than 50 different shops, appeared in the pages of the *American Machinist* during the year 1914, on oxyacetylene-welding apparatus, methods, fixtures, times of production, and

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costs. I think it may be safely said, that the *American Machinist* contains the pioneer technical literature on autogenous welding.

Oxyacetylene welding, as it is practiced today, is one of the most important processes in both automobile construction and repairs. In order to perform welding successfully, correct technique and efficient manipulation of the welding torch are all-important. The apparatus also should be of modern design and up to date for all requirements.

The oxyacetylene welding torch may be relied upon to make good the ravages of wear-and-tear, the damage caused by friction and incessant vibration, or the disastrous effects of structural-injury fracture, or other accidental damage, no matter of what metal the part may be made or how much it weighs. Regarding the strength of an oxyacetylene weld, it is advisable to assume that the weld is to be machined to the original section, for it is obvious that by the method of reinforcing, welds can be produced that are stronger than the parts joined, purely by virtue of increased cross section. Tests show, however, that from 85 to 95 per cent of the original strength may be considered a good average, without reinforcement. By reinforcements on the weld, almost any efficiency can be obtained.

Broken and cracked aluminum castings, which only a few years ago would have been deemed entirely irrecoverable, can today be repaired equal to new with the oxyacetylene torch at less cost than by any other method. In fact, this process has so strongly demonstrated its utility during the past few years, that it is now recognized in the automobile repair shop as the only method of obtaining homogeneous welds in aluminum or its alloys. These remarks are equally applicable in the case of broken and cracked automobile cylinders

Importance of Preheating

Auto cylinder repairs should be undertaken only by experienced welders, because in some instances the welded joint, although it may appear satisfactory on the surface, may be very unsound underneath. In the repairing of cylinders having broken flanges or other projecting parts, new metal generally can be built up without preheating the entire casting. The edges of the breaks must be properly beveled as well as the edges of the replacement pieces. When repairing broken or cracked water jackets or cylinder walls, the whole casting should be preheated to about 1,150 deg. F. (a dark cherry color) so as to avoid distortion and possible cracking resulting from unequal contraction when cooling. The heated casting should be placed on a welding table and the flame applied together with the welding material, so that the latter can penetrate completely through to the other side of the fracture, thereby securing a sound weld.

Should a combustion head be cracked, it is frequently necessary to cut away part of the water jacket wall so as to reach the fracture. When this has been done the piece of metal cut away, is replaced and welded in position after the inner repair has been completed.

Conditioning or after treatment of autogenous welds on motor-vehicle parts should never be omitted. It should be mentioned however, that after treatment will not change a bad weld into a good one. The structure of the welded area is such that the metal in the zone is generally weak compared with that of the material in its immediate neighborhood. This weakness can be eliminated in a large measure either by heat, or mechanical treatment, or both. Hammering the metal in the welded area improves the mechanical qualities of steel welds, and heat treatment produces a finer and more even grain and removes internal strains and stresses. The after treatment of cast-iron welding jobs consists in annealing and allowing the work to cool down very gradually in the absence of drafts.

In regard to the employment of bronze filling material for the welding of cast, malleable and steel parts, it may be well to state that the bronze used in welding these metals is not the well known bronze, of commerce, since it sometimes consists of copper, zinc, iron, manganese and tin. Those readers who are interested in the welding of the above mentioned metals with bronze filler rods, should peruse the interesting and instructive article on page 652, Vol. 62, of the *American Machinist*.

In our welding shop, Monel-metal filler rods are used for repairing cracked and fractured cast-iron and malleable parts. This material is very advantageous, in that it not only penetrates the metal under treatment and produces a homogeneous weld, but at the same time produces a weld soft enough for machining.

S.A.E. Proposes Unification of Wire Gages

The American Engineering Standards Committee has been requested by the Society of Automotice Engineers to take up the unification of wire and sheet metal gage systems in order to arrive at a national standard system of designating the diameters of metal wires and the thicknesses of metal sheets. The systems of gage numbers by which these products are generally designated at present have been developed and adopted in the course of time in different trades and for different products, and as a result there are now listed 13 gage systems in this country alone. This wide diversity necessarily leads to confusion, and some organizations, in order to avoid it, have entirely done away with gage numbers and designate wire and sheet metal sizes exclusively in decimal fractions of an inch.

A conference of all industrial groups interested in this problem will be called in the near future to discuss the desirability and possibility of unifying the various existing gage systems into a consistent national system. This conference will also consider the question of whether it is feasible or not to thin out the series of diameters or thicknesses actually listed in the catalogs of different trades. The A.E.S.C. and the Division of Simplified Practice of the Department of Commerce have made arrangements to co-operate actively in this matter.

The A.E.S.C., whose address is 29 West 39th St., New York City, will be glad to receive any suggestions with regard to the general technical problem, or any of its phases.

The modern method of production is to keep material on the move while the men stand still.

Accuracy and Production in Gear Hobbing

By D. Vaughn Waters
Mechanical Engineer, Gould & Eberhardt

Method of generating involute tooth forms by the hobbing method—Design features that must be incorporated in hobbing machines to produce accurate results

THE involute curves on gear teeth are usually generated by a series of fixed planes on a tangent rolling without slippage on an evolute or base circle. Practically, these fixed planes are the sides of rack teeth, and the pitch line of the rack, or the plane which is tangent to the circle on the gear, is the rolling tangent referred to above. In Fig. 1, this is illustrated.

Gear hobbing is one form of the molding-generating process of gear-tooth cutting, and may be briefly described as that method in which the rotating helicoidal cutting elements of the hob envelope a true basic rack section in a plane normal to its teeth, and, when fed across the face of a suitable rotating gear blank parallel to its axis, generate, or cut teeth in its periphery. This is illustrated diagrammatically in Fig. 2. The gearing connections necessary in a typical hobbing machine to revolve the gear blank at the proper velocity, relative to the hob, are shown in Fig. 3. The indexing is continuous and progressive and practically eliminates tooth spacing errors. The tooth shape is produced as a result of the synchronized movement of various elements of the machine, instead of being dependent upon the shape of a cutter. Accurately hobbed gearing is a product of three agencies, the hobbing cutter, the machine (including work-holding fixtures), and the operator. These agencies are inter-dependent, and faults in any one will affect the quality of the gears cut.

Hobs, as made today for accurate work, have all the tooth surfaces ground after hardening. They are carefully inspected before shipment, and a graphic record of their departure from theoretical exactness is made. An account of hob inspection, with illustration of these records, written by S. O. Bjornberg appeared in *Machinery*, issue of April 1923, under the title, "Quality Control in Gear Manufacture." •Practical elimination of error is secured with single threaded hobs. Multiple threaded hobs, however, are still difficult to produce to the degree of truth desired for gears of the highest quality. Uniformity of tooth spacing between adjacent threads is not always secured, and the gear cut with one of these hobs may have periodic errors in spacing around its circumference, equal in number to the quotient of the number of teeth in the gear and the number of threads in the hob. Development work in connection with multiple threaded hobs is going along, and the accuracy in their manufacture required will eventually be secured.

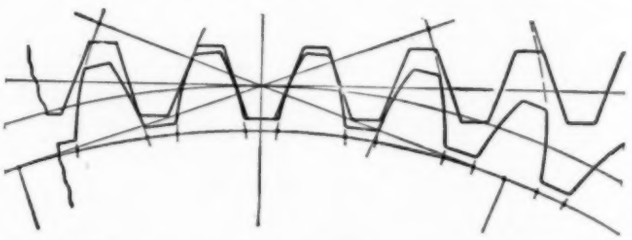


Fig. 1—Generation of involute tooth form by means of rack

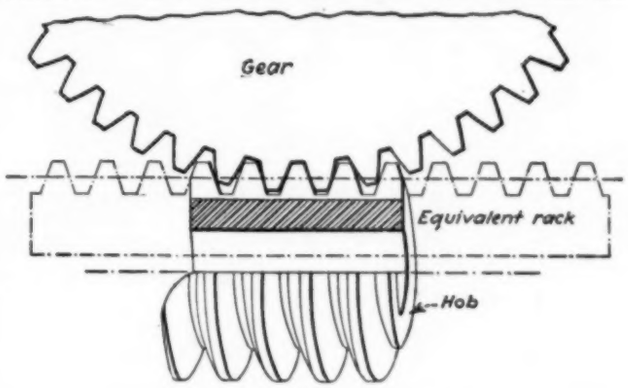


Fig. 2—Helical hob generation of involute gear teeth showing relation to rack method

Turning, now to the hobbing machine, maximum allowances must be determined for the variation from truth of certain component parts. With present machining facilities it is possible to commercially produce these parts well within the prescribed limits, and no trouble is experienced in building hobbing machines that are initially accurate. Due to improved methods of compensating for unavoidable wear, this accuracy can also be maintained over a long period of service. However, the principal causes of the inaccurate output of a hobbing machine will be enumerated below, to facilitate diagnosis should trouble arise.

The most vital part in a hobbing machine is, naturally, the master, or index, worm and its mating gear. If the thrust faces of the worm are not square with its axis, an acceleration and retardation will be imparted to the blank for each revolution of the worm. The finished gear will then have a number of periodic errors in tooth

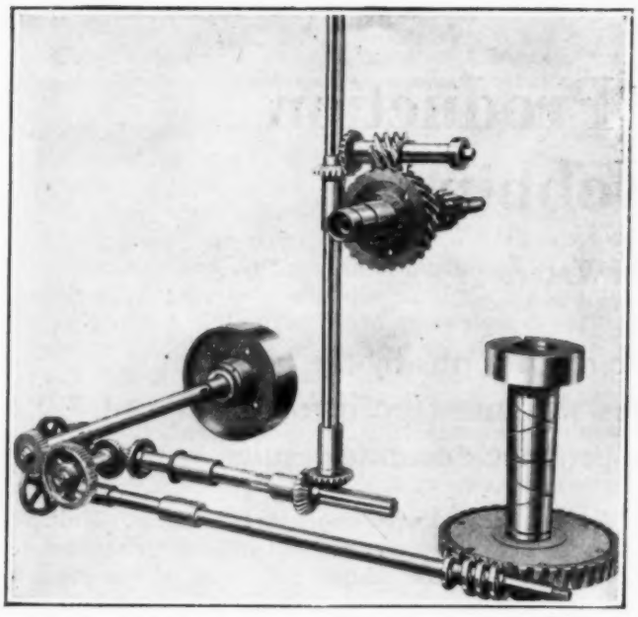


Fig. 3—Gearing connections in a typical hobbing machine

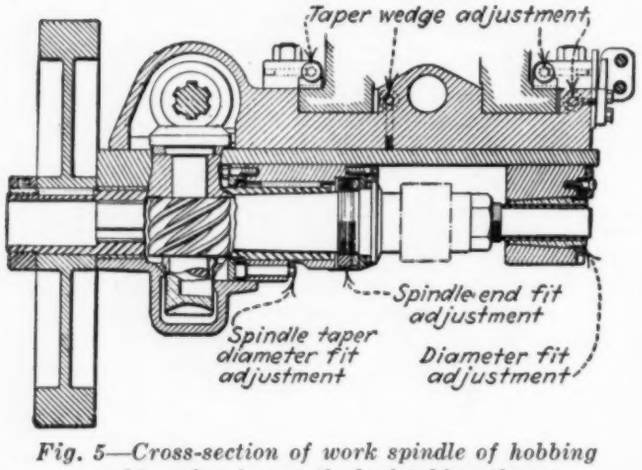


Fig. 5—Cross-section of work spindle of hobbing machine showing method of taking thrust

spacing. Nearly perfect parallelism of the washers adjacent to these thrust faces is also necessary as otherwise the errors mentioned may be either aggravated or neutralized depending upon whether the high places on each member coincide, or are on opposite sides of the worm axis.

The pitch circle of the index wormwheel must be concentric with the work spindle. An eccentric wormwheel will not have uniform pitch-line velocity but will accelerate for one half of each revolution and decelerate for the remaining half. This will cause a spacing error on the gear being cut, which increases uniformly for one half the circumference and decreases for the remaining half.

This is illustrated in Fig. 4, which shows clearly that the wormwheel, and consequently the gear blank, accelerates and decelerates an angular amount, ϕ. Letting a equal the pressure angle of the worm, d equal twice the eccentricity, and r equal the pitch radius of the worm gear, then $\phi = \frac{d \cdot \tan a}{r}$ radians, usually a very small value, but the spacing of the gear being cut is materially affected. The index wormwheel should also have very accurate tooth spacing to obviate like errors in the gears cut.

In this connection, index wormwheels for hobbing machines have sometimes been made of the "split ring" type, in which one-half of the face and tooth surfaces were carried on a ring bolted to the main member, and the possible errors in spacing were distributed and minimized by rotating the ring to different positions relative to that in which the gear was hobbed. It has been found, however, that with modern facilities, one-piece wormwheels can be hobbed which are more accurate than those utilizing the "split-ring" method and which are also much cheaper.

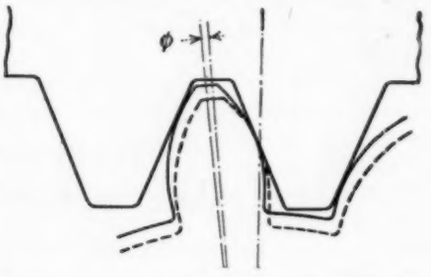


Fig. 4—Angular error introduced by eccentricity of index wormwheel pitch circle with respect to work spindle

The cutter spindle of a gear-hobbing machine is also a vital factor in the quality of work turned out. The thrust faces which locate the spindle axially should be situated as close to the hob as possible, so that the elongation of the spindle, due to heat, and the resulting axial displacement of the hob will be negligible. In Fig. 5 is shown a cutter-spindle design incorporating this desirable feature.

The thrust faces and thrust washers on the cutter spindle must also be square and parallel respectively, as otherwise there will be errors in the spacing of the finished gear, caused by the resulting axial displacement of the hob. Accuracy of helical gears cut on a hobbing machine is dependent, also, upon perfection of the surfaces of the washers taking the thrust of the feed screw, and upon the accuracy of the lead of the screw itself. Defects in these members will cause a wavy bearing on the teeth of the gears.

In general, a measurable defect in any member of the gearing train between cutter and work will have an effect upon the accuracy of the gear cut. A suitable analysis, however, usually reveals the defective part, and correction can be made accordingly. Testing fixtures are available, which, if any detectable inaccuracy exists in this train, will trace a graphic chart from which the location and magnitude of errors can be deduced. Such a fixture is described in an article by the writer which appeared in *Machinery*, December, 1922.

A weak design of work-holding fixture, or an in-

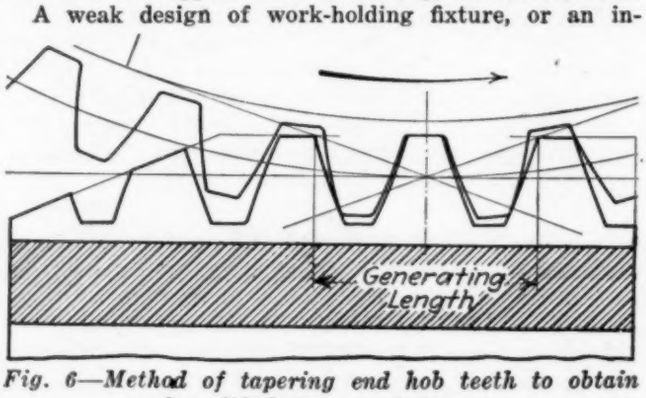


Fig. 6—Method of tapering end hob teeth to obtain long life between grindings

securely supported work arbor will affect the finish and accuracy of gears held thereon. There should be sufficient rigidity and stiffness in these members to obviate any appreciable deflection of the work, as such deflection will produce chatter marks, different sized gears (when cut in stacks) and other faults. Blanks should be mounted as close to the work table as possible and securely clamped thereto to insure good work. Work fixtures incorporating these desirable features will be illustrated.

If a careless operator allows dirt to get between the fixture and the gear blank, or under the clamping nut or collar, or does not set the cutter or work mandrels true, eccentric gears will be produced. Continuing to use a dull hob will produce gears with poor finish, as the metal is not cut cleanly from the sides of the gear teeth.

A higher production is usually possible with the hobbing method of gear cutting than with other methods, as there are a multiplicity of cutting teeth in action simultaneously, with no idle returning time between cuts, or between each tooth, as in other types of machines. In rough hobbing operations, preparatory to finish hobbing or grinding, greater production can be

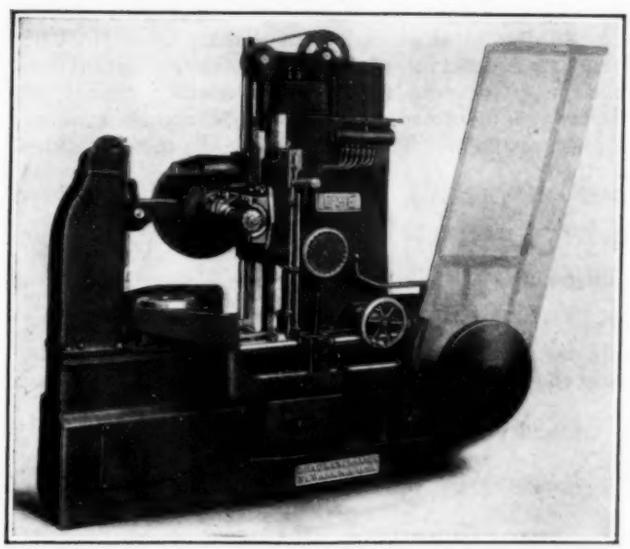


Fig. 7—Modern vertical-cutting type hobbing machine for precision work

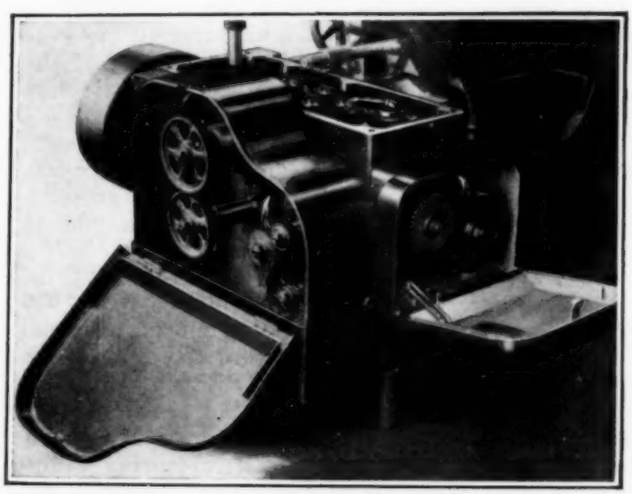
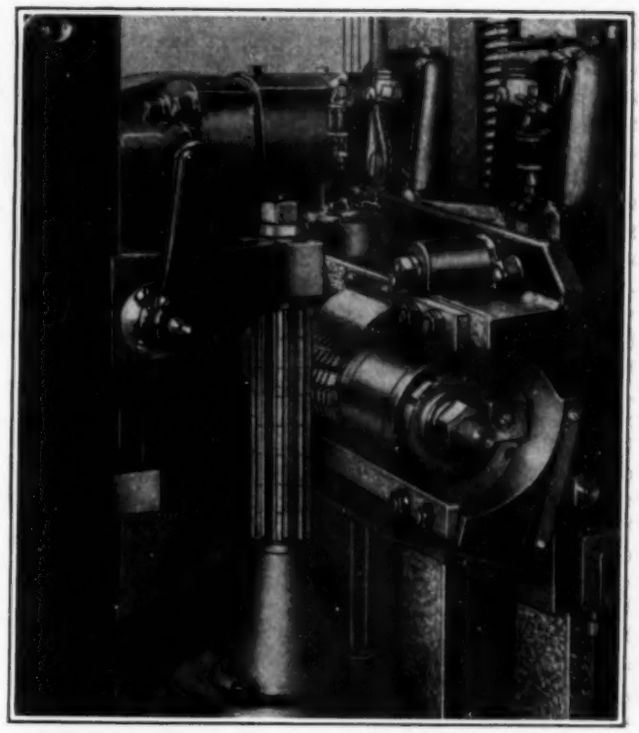


Fig. 8—Lubrication system employed to insure absence of wear in the vital gear trains of a hobbing machine



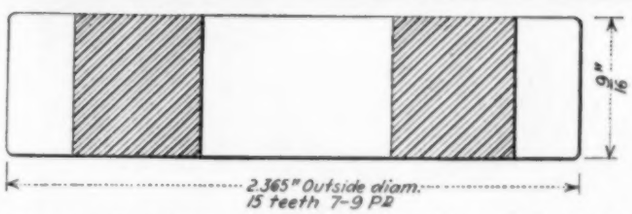


Fig. 9—Roughing eight gears per setting with double thread hob: production 115 gears per hour

obtained by using hobs with cutting faces hooked or undercut 5 deg. to 10 deg. from a radial line intersecting the tip of the tooth. The metal is then removed with less expenditure of power and less strain on the machine, due to the shearing action of the cut.

A greater length of hob life between grindings is often secured by tapering for a few teeth that end of the hob against which the gear blank rolls when entering into mesh. This distributes the work of roughing over a larger number of hob teeth as illustrated in Fig. 6. This is especially advantageous when hobbing helical or herringbone gears.

To utilize, to the fullest extent, the production possibilities inherent in hobbing process, the hobbing machine must be designed with certain fundamental features in mind. The vertical-cutting type of machine, illustrated in Fig. 7, incorporates, to a marked degree, the rigidity required, as the strains incident to high cutter speeds and heavy feeds are transmitted directly to the base of the machine, which has mass sufficient to absorb them without undue vibration. The heavy box-type outer support to the work arbor is also a vital factor in minimizing deflection of the work under heavy cuts.

The guideways upon which the hob carriage slides are not subject to the deposition of chips or dirt. This construction, together with the strong, square-lock form, easily adjustable for wear, tends to increase both the production and accuracy attainable.

All components of the drive between cutter and work

spindles should be ample in size and rigidly mounted, with splined, sliding members. If, in addition, a flywheel is mounted on the cutter spindle, the hammering action of the hob when entering the work will be minimized, resulting in more accurate work and longer hob life.

Centralized control of the different movements of a hobbing machine will greatly increase its output. This is true of other types of machine tools also, and is being given attention in most new designs put upon the market recently.

Rapid power traverse to the cutter is as essential on a hobbing machine as on other machine tools and is embodied in recent designs. It greatly reduces the loading time and enables the operator on production work to look after a greater number of machines.

An efficient lubrication system which will insure a continuous and ample supply of clean oil to all bearings is necessary, and an inspection of recent designs shows that much care has been taken in working out this feature.

In Fig. 8 is shown a photograph of the gear case at the rear of this hobbing machine with the guards over the change-gearing opened. The guards are of oil-tight construction and when the machine is in operation the pipes seen near the top of the guards flood the change

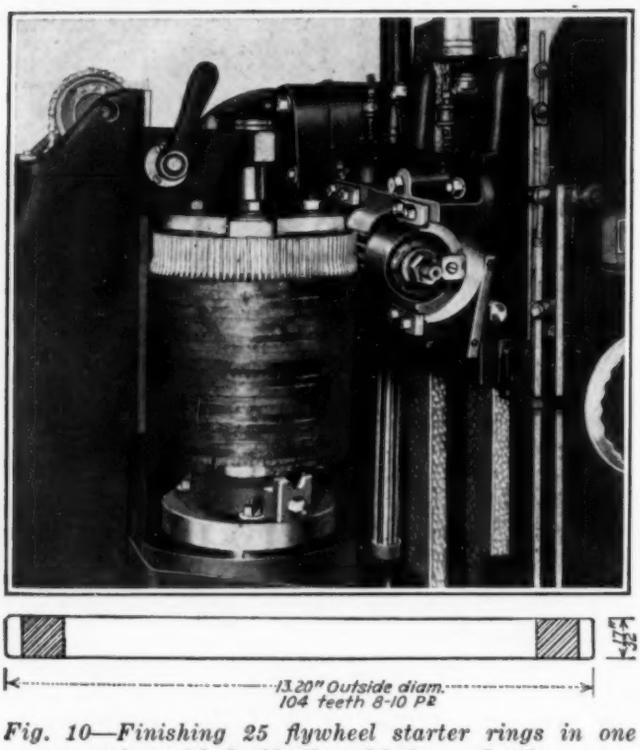


Fig. 10—Finishing 25 flywheel starter rings in one setting with double thread hob: production 19 rings per hour

gears and bearings with a copious supply of oil, which is then returned to a tank and used again. This feature of cascade lubrication to the change gearing on a hobbing machine is a late development and will, no doubt, lengthen the life and preserve the accuracy of the members.

In Fig. 8 is also illustrated the method of lubricating the various gears, bearings, etc., inside of the gear case. Oil is pumped into a shallow pan lying over these members, and falls directly on them through small holes in the bottom of the pan, eliminating much piping. As mentioned before, ample provision should be made on a production hobbing machine for quick and easy adjustment of those parts which wear in normal service.

In Figs. 9 and 10 are shown recent examples of production hobbing, with leading dimensions and fixtures illustrated. The floor to floor time for each gear is also given. Acknowledgment is made to Gould & Eberhardt, Newark, N. J., for permission to reproduce photographs, and to use certain data.

Selecting Lead Gears for a Hobbing Machine

By Lester A. Demkier

On pages 25 and 400, Vol. 63, of the *American Machinist*, were published methods of finding lead gears to produce prime numbers of teeth. Perhaps readers of the *American Machinist* will be interested in learning of a simple and practical method of cutting prime numbers of teeth on a hobbing machine.

This method consists of raising the fraction to one of a rather high denominator, subtracting 1 from or adding 1 to both numerator and denominator, and factoring the result into suitable compound gearing.

To illustrate, take the cutting of a spur gear of 293 teeth, 22 diametral pitch, on an Adams Gear Hobber, which has a constant of 30. The proper combination would be 30 driving 293. This obviously cannot be used, as it is assumed that there is no change gear of 293 teeth available. Therefore, using the method above described:

$$\frac{30}{293}\times\frac{50}{50}=\frac{1500+1}{14650+1}=\frac{1501}{14651}$$

$$\text{Factoring: } \frac{1501}{14651}=\frac{19\times 79}{7\times 23\times 91}=\frac{22}{77}\times\frac{38}{92}\times\frac{79}{91}$$

This compound gearing can be used to generate 293 teeth, but the gear cut will have a slight helix angle, due to the accumulated error. The amount of error can be found as follows: Reducing $\frac{30}{293}$ and $\frac{1501}{14651}$ to a common denominator, they become $\frac{439530}{4292743}$ and $\frac{439793}{4292743}$ respectively. Consequently, the error is $\frac{263}{4292743}$ of 41.84″ (the pitch circumference of the gear), or about 0.0025″ per revolution of the table.

It is apparent that the greatest permissible feed is desirable, in order to keep the total error in the gear down to a minimum. It will also be noted that the error is lessened as the number by which the fraction is multiplied is increased.

The gear produced by this method will not be sufficiently accurate for use in machinery, but it will contain the correct number of teeth, properly spaced, and consequently it can be used on the hobbing machine to generate a very accurate index gear.

When a motor truck shop employing close to 4,000 workers can cut the accidents due to moving material to only eleven per year, it's a record for all shops to shoot at. Of the eleven accidents only two were fractures, eight were contusions and the remaining one was a laceration. The remarkable record resulted largely from improvement in material-moving equipment. The saving in actual expense for accidents was over $6,000 a year.

Modern Tooling Methods for Turret Lathes

By M. E. Lange
Production Engineer, The Warner & Swasey Co.

Universal equipment for bar work—Comparative costs of equipment methods—The permanent set-up and what can be done with it—Inventory of tool equipment

THE suggested universal set of bar tools is shown in more detail in this article. The set illustrated is for a 1½-in. turret lathe, and will handle the majority of the work within the cutting range of the machine. Similar sets may of course be developed for other sizes of machines. Simple tool diagrams of each tool are given for actual use when planning tool layouts. Many operators do not have a thorough grasp of the principles of tooling, and as a result their set-ups are only partly correct. By preparing simple layout blueprints, the most efficient combination of tools can be determined and permanently recorded. Such layouts may be similar to those used in these articles. The individual tool diagrams may be used in making such layouts by tracing them on transparent paper suitable for blue printing or photostats can be used.

A turret lathe provided with universal bar equipment will perform operations of turning, chamfering, threading and forming on a great variety of work. In many cases such equipment makes a turret economical for use in quantity production as well as for small lots

An individual tool diagram and a flanged tool holder with combination stock stop and center are shown in Figs. 49 and 50. The holder is used for locating the bar from the chuck, and for supporting the work for centering, necking, and so forth.

An individual tool diagram and a single-cutter turner are shown in Figs. 51 and 52. This turner is a rigid tool with roller backrest for accurate work. The cutter can be withdrawn to prevent marring the work.

An individual tool diagram and a multiple-cutter turner are shown in Figs. 53 and 54. This turner is a substantial tool for turning or chamfering two or three diameters at once to accurate limits. Several roller carriers can be used on the one tool.

An individual tool diagram and an end facing tool are shown in Figs. 55 and 56. This tool is used for facing or rounding ends prior to threading. The flat cutter has a rocker adjustment for setting to center.

An individual tool diagram and a center drilling tool are shown in Figs. 57 and 58. This tool is used for centering ends of shafts concentric with outside diameter. The rolls are adjusted all at once by a knob.

An individual tool diagram and a self-opening diehead are shown in Figs. 59 and 60. The diehead is used for rough and finish threading.

The fourth article. The fifth will appear in an early issue.

Let us now study carefully the exact work that this tooling equipment will do. If it is to be universal in its application, the equipment must handle efficiently a large variety of sizes, materials, types and quantities of work in order to be all that its name implies.

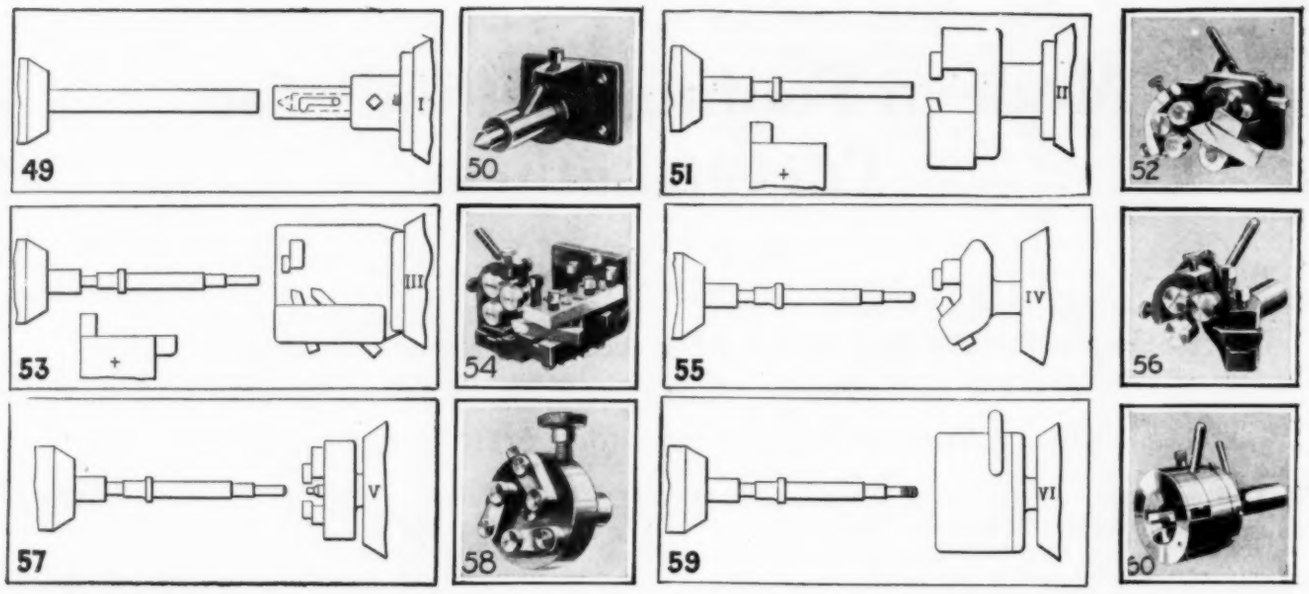
Several groups of different pieces actually made on a 1½-in. machine are shown in Fig. 61. No additions or substitutions of tools were made. The type of work varies widely, and the difference in size of these parts emphasizes the universal nature of the tooling equipment that produced them. The size of the lot varied from 5 to 100 pieces.

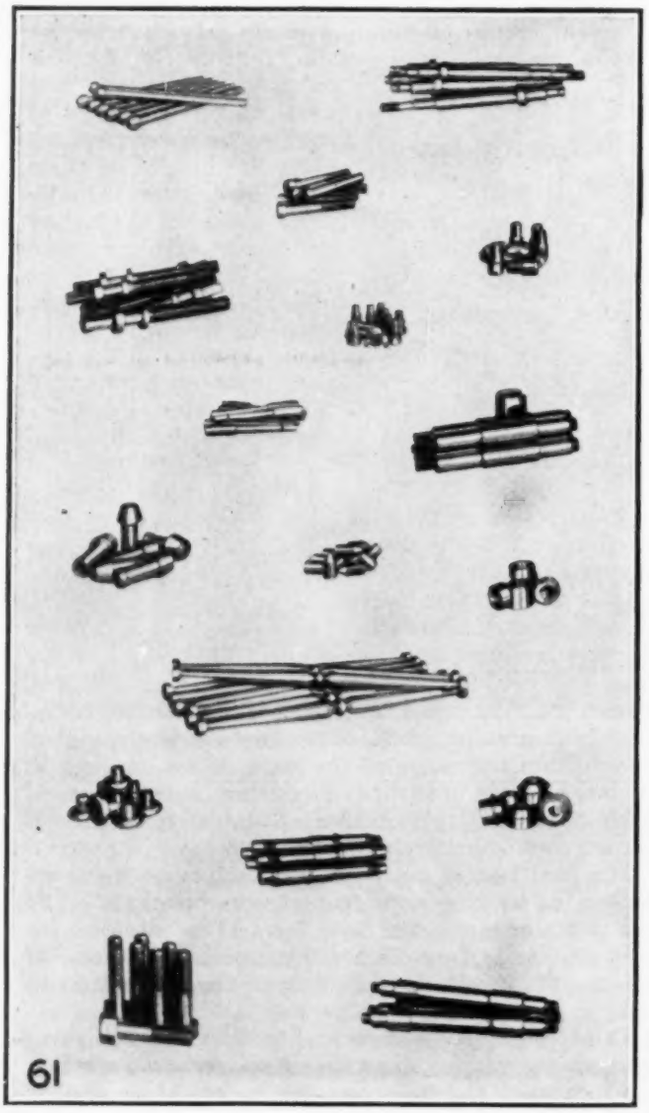
The universal bar equipment, arranged in the permanent set-up, performs all the operations on these pieces without any additions or substitutions of other tools. For quantity production, the smallest of these pieces would be produced on a 1-in. capacity machine, but for average conditions a range of from ⅜ to 1½ in. can well be handled on the 1½-in. machine.

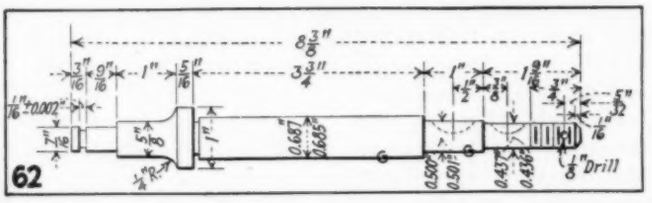
A study of the work in the average shop will show a surprising similarity to the types illustrated. Work from the bar must be turned, chamfered, threaded, formed, etc. A turret lathe with universal bar equipment will perform these operations efficiently, on all work within the range of the machine for which it is arranged. Even in quantity production, such equipment often equals the performance of special tools and, of course, costs considerably less.

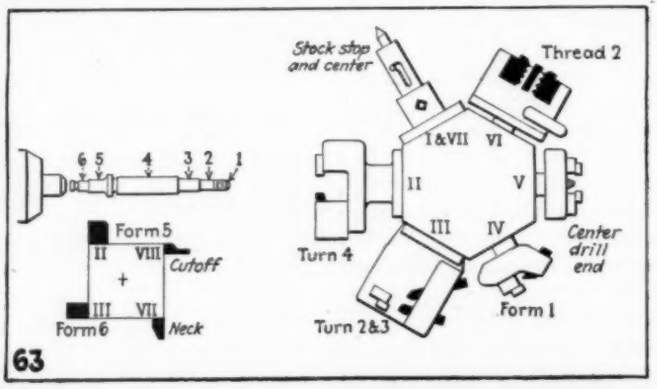
The final test of universal tool equipment is a comparison of its cost with that of other methods. The cost of a standard set of tools for a 1½-in. machine, for example, varies from 15 to 20 per cent of the cost of the machine itself, depending upon the type of cross-slide.

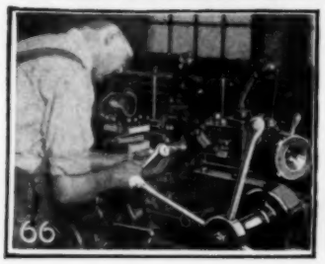
This cost must be compared with that of making tools in the shop. Many manufacturers assume that for such work the tool room has no overhead, or they oevrlook the designing and experimenting time. Then too, the limited range of work of special tools, means a large investment to cover all the different work produced in a period. In too many cases the interest charges on such investment is overlooked or ignored.

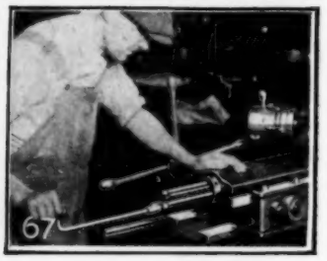




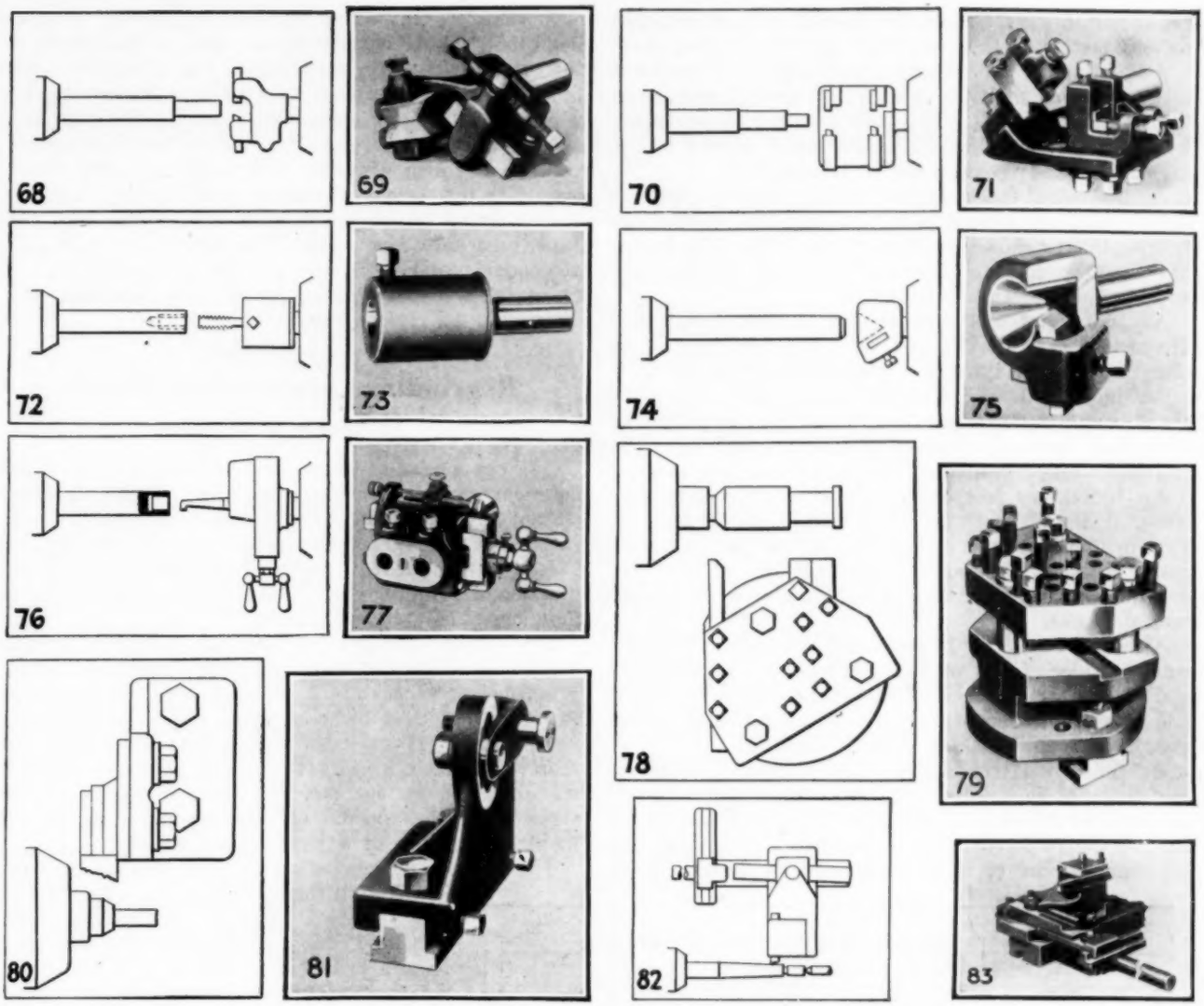








Figs. 49 to 60—Individual tool diagrams and various tools used in universal equipment for bar work. Fig. 61 —Typical work produced with universal bar equipment. Fig. 62—Drawing of spool spindle. Fig. 63— Permanent tool set-up. Changes necessary for making spool spindles are shown in heavy black Fig. 64—Changing collet bushings. Fig. 65—Sharpening cutters Fig. 66—Setting cutters. Fig. 67—Setting stops



Figs. 68 to 83—Individual tool diagrams and additional tools used in permanent set-up

Universal types of tool equipment will reduce the tool cost considerably, and a small set of tools is all that is needed for a wide variety of work.

The permanent set-up gives the arrangement of universal bar equipment that is best suited for the majority of bar work. The tools used are those shown together with the individual tool diagrams in Figs. 68 to 83. The set-up is kept intact for different jobs and, if necessary, the turret is back indexed to obtain the correct order of operations. Unless the quantity produced is large, any individual tools that are not used for a particular job, remain on the machine, and are shown dotted in the tool layout given the operator.

Thus in changing from job to job, tools do not have to be removed and the set-up time is limited to: Changing the collet bushings. Sharpening the cutters. Setting the cutters. Setting machine stops.

The changes necessary for setting up a typical bar job, the spool spindle shown in Fig. 62, are shown in Fig. 63 in heavy black in the layout and are fully described. The total set-up time for this job was only 49 minutes.

The first step in setting up for this spool shaft is to change the collet bushings as shown in Fig. 64. Time, 5 minutes.

Forged cutters and bits must be sharpened to suit the individual needs of the job. This operation is shown in Fig. 65. Time, 12 minutes.

Setting of cutters to size is done while the first piece is being machined, as in Fig. 66. Positive adjustment of tools, and adjustable rockers in the square turret, reduce this time to 19 minutes.

Stops for the longitudinal travel of the square and hexagon turrets are adjusted quickly by a simple wrench, as in Fig. 67. Time, 13 minutes.

While the standard set of bar tools is complete for the majority of bar work, the great difference in conditions in different shops, or the larger quantity produced, may suggest the addition or substitution of different individual tools for particular operations.

The individual tool diagrams which follow will suggest additional tools. Each tool is universal, and will handle the entire range of work for the size of machine. The list is necessarily incomplete, as is shown by the complete tool inventory in Fig. 84, and is intended to be merely suggestive of the further possibilities of adapting universal types of standard tools to varied requirements.

An individual tool diagram and a V-backrest tool, suitable for heavy duty on soft metals such as bronze,

are shown in Figs. 68 and 69. V-rests will not roughen on soft metals as they would if used for turning steel.

An individual tool diagram and another V-backrest tool for taking multiple cuts in soft metals, are shown in Figs. 70 and 71. This tool is used to avoid the wear of the roller backrest type, which is due to the high speed and the absence of lubricant.

An individual tool diagram and a clutch, tap, and die holder that will release when the tap has reached the full depth are shown in Figs. 72 and 73. The holder has a slight floating movement, and can be used for left- and right-hand threads.

An individual tool diagram and a chamfering tool are shown in Figs. 74 and 75. The tool is used to chamfer ends for starting turners, and for rounding.

An individual tool diagram and a slide tool with shank mounting for accurate boring and recessing of short bar work, are shown in Figs. 76 and 77. The tool has a large graduated dial and adjustable stops.

An individual tool diagram and a cross-slide toolblock, front or rear, are shown in Figs. 78 and 79. This toolblock is used in the place of the standard toolpost for holding several forged cutters or bits, for multiple facing, forming, or necking, and to replace special blocks.

An individual tool diagram and a circular forming-cutter holder, front or rear, are shown in Figs. 80 and 81. This holder is for circular forming cutters, and is suitable for heavy work to close limits, where quantity permits making formed cutters.

An individual tool diagram and a taper attachment are shown in Figs. 82 and 83. The taper attachment is mounted in the rear of the cross-slide, and is used for cutting tapers or contours. The operation is rapid and accurate, as in turning tapers in an engine lathe.

1½" Plain and Geared Friction Head Turret Lathe

Bar Tool Inventory

Name	Tool No.	Inventory	Name	Tool No.	Inventory	User's Machine Number
Universal Bar Equipment			Center		1	TL-1
*Flanged Tool Holder		6	*Chamfering Tool		3	TL-2
*Combination Stock Stop and Center		3	Drill Chuck		1	TL-3
*Single Cutter Turner		4	Drill Socket		2	
*Multiple Cutter Turner		4	Floating Tool Holder		4	
*End Facing Tool		3	*Clutch Tap and Die Holder		1	
*Center Drilling Tool		3	Plain Tool Holder		1	
*Self-Opening Die Head		3	Adjustable Tool Holder		1	
Additional Turret Tools			Forged Boring Cutter		8	
*Roughing Box Tool		2	Tool Holder Bushing		6	
*Finishing Box Tool		2	**Cross Slide Tools**			
Drill or Tool Holder		1	*Taper Attachment		2	
Starting Drill		2	*Front Cross Slide Cutter Block		1	
*Slide Tool		2	Rear Cross Slide Cutter Block		1	
Vertical Slide Tool		2	Necking Block		2	
Boring and Recessing Tool		1	Straight Forming Cutter Holder—Front		2	
Duplex Tool Holder		1	*Straight Forming Cutter Holder—Rear		2	
Taper Forming Box Tool		1	Circular Forming Cutter Holder—Front		2	
Pointing Tool		2	Circular Forming Cutter Holder—Rear		2	
End Forming Tool		2				
Knurling Tool		1				
Adjustable Boring Cutter Holder		3				
Combination Stock Stop and Center Drill		2				

Collets and Adapters

Standard Collets						Master Collets					
Round	Inventory	Square	Inventory	Hexagon	Inventory	Round	Inventory	Square	Inventory	Hexagon	Inventory

Fig. 84—Complete inventory of tools for bar work

A complete inventory of tool equipment is often helpful in laying out the tools. Such a list shows *all* the tools available for a particular size of machine, and is helpful, both in laying out a job and in showing any weakness in the tool equipment available. Similar lists can, of course, be developed for other sizes of machines.

A form for a complete tool inventory, Fig. 84, is given for the tools available for a 1½-in. size, ram-type turret lathe. The tools marked with a star are, perhaps, used most frequently. The large number of tools not considered here, shows the further possibilities of universal types of tool equipment for individual conditions, or to replace special tools.

Regrinding Cast-Iron Car Wheels

BY ROBERT W. ADAMS

In a paper read at the annual convention of the Chief Interchange Car Inspectors' and Car Foremen's Association of America, held recently at Chicago, Ill., W. M. Allison, of the car service department of the Detroit, Toledo & Ironton R.R., strongly recommended that the practice of grinding slid-flat cast-iron car wheels should be adopted as standard practice.

Mr. Allison said that the Detroit, Toledo & Ironton R.R. and a number of other roads have purchased wheel-grinding machines and have made extensive tests as to safety, practical and economical phases of the use of such wheels. It has been proved that this is an item that will effect a great saving to all railroads and that it can be done successfully without damaging the strength of the wheel. In fact, the grinding greatly increases the life of a second-hand wheel.

The practice of regrinding cast-iron wheels has been in effect on the D. T. & I. R.R. for the past two years. Before the grinding machine was used, every conceivable test was made from a practical as well as a safety standpoint. Executives visited various manufacturing plants where cast-iron wheels were made and examined wheels which had been broken for test purposes. In no case did they find the chill to be less than $\frac{5}{8}$ in. deep, and since the A.R.A. specifies a minimum chill of $\frac{1}{2}$ in. on new cast-iron wheels, flat spots of from 2½ to 3½ in. can be easily ground out without affecting the chill in any manner. On some of the roads on which grinding is practiced it is said to be possible to grind out even 4- and 4½-in. flat spots.

The selection of wheels for grinding is governed by the condition of the flange height and the thickness, as well as the proper diameter and hardness. In the practice of regrinding wheels it has never been necessary to take off more than $\frac{1}{16}$ to $\frac{3}{32}$ in. in order to clear off the outside defect. The wheels are then given the Brinell hardness test which will show whether or not the wheel has been affected by the process.

About two years ago, the D. T. & I. R.R. had a pair of cast-iron wheels, made in 1911, with a slid flat spot of 2½ in., which were reground and placed under a car. These wheels have been in constant service since that time and are still good.

Autogenous Welding of Aluminum and Its Alloys

By A. Eyles
Manchester, England

Difficulties to be contended with—Pure gases necessary—Welding rods for sheets and castings—Preparing the joints—Goggles and the color of the glass

ALTHOUGH much has been written in the technical and mechanical journals during the past few years on aluminum and its peculiar characteristics, comparatively little has been published from the practical mechanics' point of view, notwithstanding the fact that this metal is now used extensively in the automobile, aircraft, electrical, and general engineering industries. The ever-widening use of aluminum and its alloys has brought with it the question of how to make repairs. A permanent repair or joint in aluminum is entirely satisfactory when correct methods are employed, but unfortunately there are too many incorrect methods, which make many mechanics not only indifferent but averse to the repairing of fractured or broken aluminum parts.

One of the cardinal arts in the fabrication of aluminum in the hands of mechanics, is the process of joining together two or more pieces of the metal. Since the jointing of aluminum and its alloys is popularly

Fig. 1—Puddling rod

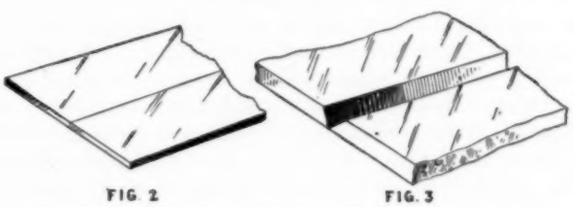


FIG. 2 FIG. 3

Fig. 2—Buttweld. Fig. 3—Edges beveled for buttwelding

supposed to be a difficult process, a few notes from one who has spent upwards of twenty years in research on various methods of such work should be of practical value and general interest.

It is well known that the art of jointing most commercial metals has been known and practiced for many centuries, but this is not the case with aluminum; since the metal is only in its infancy as compared with other common metals. The jointing of aluminum was not done by soft soldering until the year 1855, when M. Christofle discovered that pure tin would solder aluminum, but not effectively, as the tin formed an alloy with the aluminum and was decomposed by oxygen. Since that date there have been innumerable attempts made to produce an effective and easily used aluminum solder—a solder that could be used freely with the ordinary soldering copper.

It would appear, however, that no well tested process of soft-soldering aluminum or its alloys has yet been proved to be permanently successful, notwithstanding the large number of special solder compositions now on the market. On the other hand, there are undoubtedly a number of industrial applications where it is not desirable to heat the parts to be joined to the relatively high temperature necessary to autogenously weld them by oxyacetylene methods, owing to the resultant distortion of the parts, and in these cases aluminum solders are useful.

A soldered joint in aluminum is rapidly attacked and disintegrated when exposed to moisture, and there is no solder for aluminum of which this is not true. A joint, therefore, should never be made by soldering, unless it is to be protected against corrosion by a suitable paint or waterproof enamel. In view, however, of the ease with which aluminum and its alloys can be autogenously welded, the success or non success of soft-soldered joints as a factor in the development of the general utility of the metal, carries less importance than might otherwise have been assigned to it.

Autogenous welding with the oxyacetylene flame, provides a means of effecting welds that were impossible some years ago. In fact, the process has so strongly demonstrated its utility during the last decade, that it is now recognized in the automobile and general engineering industries as the most reliable method of obtaining a permanently reliable and homogeneous joint. Autogenous welding of aluminum joints, obviously makes a much stronger and more intimate union than soft soldering, there being no interposition of any heterogeneous metal, hence the expansion and contraction of the work is uniform.

Much has been written in the past decade, regarding various electric welding systems and their spheres of applicability. But, for permanent, sound joints in aluminum and its alloys, autogenous welding by the oxyacetylene flame is decidedly preferable to any of the electric methods.

The special difficulties to be contended with when welding aluminum are: The rapid oxidation of the metal, its high rate of expansion and contraction (being

approximately twice that of steel), and the relatively low melting point (658 deg. C.). It is also comparatively weak in tension, and, in welding, the chances of distortion or warping make it difficult to keep the work in alignment.

In welding aluminum with the oxyacetylene flame, it is essential that both the acetylene and the oxygen must be in a state of high purity, since at the great temperature of the welding flame (approximately 3,480 deg. C.) aluminum tends to absorb nitrogen, and if this impurity exists in the oxygen it will tend to render the work brittle and unreliable. It is known to those who have attempted to weld aluminum by means of the oxyacetylene flame, that when two pieces of the metal are to be welded together at their edges, the melted portions do not flow together properly, as in the case of iron or mild steel, where the melting point of the oxide is lower than that of the metal. The molten aluminum spreads in spherical form under the influence of the welding flame. The metallic globules or pellets consist of pure aluminum within a coating of alumina (oxide of aluminum), which has great power of resistance to the flame, and on cooling, the edges of the metal remain unjoined; hence the need of a good flux to dissolve and deoxidize the layer of oxide adjacent to the joint to be welded and permit the particles of the fused metal to flow satisfactorily together.

While it is practically necessary to use a flux when welding sheet aluminum, a flux can be dispensed with when welding castings of aluminum alloy, by employing what is known as the puddling system. Here a paddle or puddling rod is used. It is usually made of soft steel about $\frac{3}{16}$ or $\frac{1}{4}$ in. in diameter, and flattened at one end as shown in Fig. 1. The method consists of agitating the metal while molten in order to break up the layer of oxide, thereby allowing the particles of the metal to flow together. This method has an advantage in not having to make a V at the joint to be welded. On the other hand, when welds of this kind are made, there is a possibility that some oxide will remain in the joint, interfering with its strength, and will lead in time to disintegration. In other words, a weld without a flux never presents perfect homogeneity. However, in many cases sufficient strength can be obtained, particularly in automobile crankcases, gear covers, transmission covers, sump cases, induction pipes, etc., without the use of a flux; but even then a good flux will be found beneficial, for it will attack the layer of oxide almost instantaneously.

Fluxes should be obtained from a reliable firm making a specialty of this particular line. Fluxes prepared by welders are seldom economical or satisfactory, since their manufacture necessitates care in the selection of materials and compounding to secure commercial purity, correct proportions and intimate mixing. Welders rarely have either the necessary equipment required to compound the materials in correct proportions, or the experience in buying chemicals necessary to ensure the quality necessary.

Welding fluxes for aluminum are usually in the form of very fine powder, and should be used strictly according to the instructions accompanying them. They should be kept free from dirt and dust, and when not in actual use, they should be kept in airtight tins or bottles, because they are very hygroscopic and liable to deteriorate by absorption of moisture when exposed to the atmosphere for any length of time.

Table II—Melting Points of Different Ingredients Used in Fluxes for Aluminum Welding

	Melting Temperature
Cryrolite	1,765 deg. F.
Sodium fluoride	1,656 deg. F.
Potassium fluoride	1,454 deg. F.
Sodium chloride	1,418 deg. F.
Potassium chloride	1,346 deg. F.
Potassium bromide	1,297 deg. F.
Lithium chloride	1,112 deg. F.

Aluminum welding fluxes that are now employed extensively with very satisfactory results, consist of various combinations of alkali chlorides, fluorides, bromides, sulphates, etc. Table I gives the chemical analyses of several fluxes in use, and most of them are patented.

A good flux having a melting point of approximately 1,112 deg. F. is one containing a mixture of lithium and potassium chlorides, potassium bisulphate and potassium fluoride. The reactions that take place in fluxing are, it is thought, as follows:

The potassium fluoride reacts with the potassium hydrogen-sulphate, forming hydrofluoric acid, and this immediately acts on the aluminum oxide, forming aluminum fluoride, which is free to combine with the excess of potassium fluoride existing in the flux to form potassium aluminum fluoride, and this is capable of dissolving a further quantity of aluminum oxide. The lithium and potassium chlorides added, serve the purpose of lowering the fusion point of the mixture.

Another viewpoint is that the potassium bisulphate may act partially alone, for on heating this salt to a temperature higher than its melting point it forms potassium pyrosulphate, and on further heating breaks up into potassium sulphate and sulphur trioxide. Since this decomposition takes place at above 1,112 deg. F., it can be understood how the bisulphate will

Table I—Aluminum Welding Fluxes

Potassium Chloride	Sodium Chloride	Lithium Chloride	Sodium Fluoride	Potassium Fluoride	Potassium Bisulphate	Sodium Bisulphate	Potassium Sulphate	Sodium Sulphate	Cryolite	Potassium Bromide
83.0	17.0	....	....	...	...	...	...	...	...	...
79.0	16.0	....	....	...	...	...	5.0	...	...	...
62.7	12.5	20.8	....	...	4.0	...	...	...	...	...
62.5	32.5	....	....	...	...	...	5.0	...	...	...
60.0	12.0	24.0	....	...	4.0	...	...	...	...	...
56.0	6.5	23.5	....	....	...	...	...	4.0	10.0	...
45.0	30.0	15.0	....	7.0	...	3.0	...	...	...	...
40.0	30.0	10.0	10.0	...	...	...	...	...	...	10.0
33.4	....	33.3	33.3	...	...	...	...	...	...	...
4.2	79.2	7.4	....	...	...	...	...	...	9.2	...
....	86.0	....	....	...	...	...	...	14.0	...	...

decompose substances like cryolite and calcium fluoride at a lower temperature than that required to fuse the mineral or salt itself.

When aluminum castings are to be welded, that may have sand on the surface, a flux that will remove the sand is almost imperative. If not removed, the sand will in part be reduced and silicon will pass into the metal, reducing its strength appreciably. A suitable flux for this class of work is composed of potassium chloride and fluorspar. This flux will, on fusion, dissolve the silicon and prevent combination with the aluminum.

There are various ways of applying the flux; either by wetting the surfaces to be welded; in paste form; by heating the joints and sprinkling the flux along them; or by the safer and better method of heating the end of the welding rod and dipping it in the flux, which will readily adhere to it. It should be unnecessary to apply more flux to the weld than will varnish the rod. Too much flux is harmful. If the welding rod is varnished with flux for about 4 in., the gradual melting up of the rod as the weld proceeds, will automatically feed flux to the weld just at the position where it is required. The practice of dipping the heated end of the rod in the flux at intervals and completing the weld, as it were, in sections, should be avoided, because it is liable to cause flux inclusions at some points and inclusions of oxide at others. Consequently this method cannot tend to the formation of a good homogeneous weld.

If a paste flux is used, it can be applied by using a piece of clean cloth or rag and dipping it in the mixture. Both of the edges to be joined should be covered with the flux for at least ½ in. from the line of welding. This will effectually remove surface oxide. Should additional flux be required in order to obtain a uniform flow of the metal, it can be applied by means of the welding rod, or a piece of round-iron rod flattened at one end. Don't throw the flux on the weld in excess, as the mechanic does when brazing copper or brass. The flux should be used sparingly, and on the metal only where needed.

For welding sheet-aluminum and parts made of the pure metal, the filling material should consist of a wire or rod of pure aluminum, and for aluminum alloys, the filling material should have practically the same composition as the metal to be welded. The minimum size of welding rods used for all sizes of aluminum sheets below ⅛ in., is about 1/16 in. in diameter, while even for very thick sections, welding rods of over ⅛ in. in diameter are rarely used. Table III gives convenient sizes of welding rods for use on aluminum and its alloys.

Table III—Sizes of Welding Rods for Aluminum and Its Alloys

Thickness of Metal to be Welded (in Parts of an Inch)	Thickness in Millimeters	Diameter of Welding Rod
0.03125 or 1–32 in.	0.7937	0.078125 or 5–64 in.
0.0625 or 1–16 in.	1.587	0.09375 or 3–32 in.
0.125 or 1–8 in.	3.175	0.109375 or 7–64 in.
0.1875 or 3–16 in.	4.762	0.125 or 1–8 in.
0.250 or 1–4 in.	6.349	0.1875 or 3–16 in.
0.375 or 3–8 in.	9.524	0.21875 or 7–32 in.
0.500 or 1–2 in.	12.699	0.250 or 1–4 in.
0.750 or 3–4 in. and up	19.049	0.3125 or 5–16 in.

Should the operator at any time find himself without the usual welding wires or rods when welding pure aluminum, or if the diameters of the rods he has are unsuitable for the work in hand, strips of sheet aluminum of similar sectional area may be used satisfactorily; but the width of the strips should vary according to the thickness of the aluminum to be welded—that is to say, the width should be from two to three times the thickness of the metal up to ⅛ in. thick; one and a half times to twice the thickness for ⅛ in. to ¼ in. thick; and of a width slightly greater than the thickness of the aluminum up to, say, ¼ in. thick. If suitable folding or forming machines (as used by sheet metal workers) are available, the strips of aluminum can readily be bent or formed somewhat similar to a welding rod, and are then more easily handled.

Pure Aluminum Not Practicable

A truly homogeneous weld is seldom obtained in aluminum alloys, the composition being so extremely variable. To be sure of obtaining a homogeneous weld, it would be necessary for the filling material to be of exactly the same composition as the parts to be welded. Unfortunately, the welding operator is often in doubt as to the exact composition of the alloy to be welded, consequently many operators use pure aluminum, a practice not to be recommended. When pure aluminum is used, the weld zone will be softer and more flexible than the alloy, and constitute a defect that should be avoided, especially in the case of automobile castings, where great strength is required to enable them to withstand road shocks and excessive vibration.

The weld zone, if too soft, will be almost certain to break out, and it is essential that the filling material should contain a percentage of copper, so that the welded joint will have a hardness approximately equal to that of the casting itself. An alloy of 92 per cent aluminum and 8 per cent copper will give satisfactory results. It can be cast in sticks or rods ¼ to ⅛ in. in diameter and from 12 to 14 in. long. The average melting temperature of aluminum alloys is near to 660 deg. C., though a slight variation must be made to suit the particular alloy and to ensure the complete filling of the mold. A pyrometer is an advantage in determining the temperature, and its use is better than depending upon the color or sight of the metal, however skillful the operator may be.

As indicated above, the welder is often in doubt as to the exact composition of the casting to be welded, and even should he know its composition, it is difficult to make a proper welding stick to produce a truly homogeneous weld. It is generally advisable, therefore, to purchase aluminum-alloy welding material from responsible concerns who have the physical and chemical facilities for welding-rod determinations. The slight difference in increased cost for good welding rod, is an economic expenditure, resulting in quicker and better work.

The welding operator should remember that any aluminum job to be welded must be properly prepared, cleaned, lined up, held rigidly in place, etc., before any attempt is made to commence actual welding. "A weld well prepared is half done" is a true saying. Hence it is impossible to overestimate the importance of adequately preparing the work prior to welding. Metal that is clean is much more likely to make a good, strong, weld than when impurities are present. Grease, oxide, and foreign matter will contaminate the weld and

necessarily weaken it, and not infrequently set up automatic disintegration in the line of welding. Impurities may also make the work porous and cause cavities or blowholes in the welded joint.

Various methods of cleaning are in use for aluminum and its alloys; washing with gasoline, kerosene or benzine; immersion in a solution of caustic soda; scratchbrushing; sandblasting; scraping; chiseling; etc., the essential factor being to remove, as perfectly as possible, all impurities from the vicinity of the weld. To clean aluminum castings, immerse them for a few seconds in a hot bath consisting of 10 per cent caustic soda. After being removed from the bath they must receive a thorough washing and brushing in plenty of clean water. In the case of oily or greasy castings,

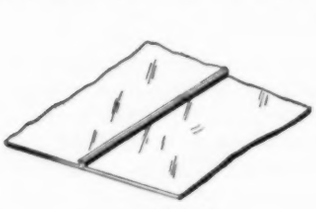


FIG. 4

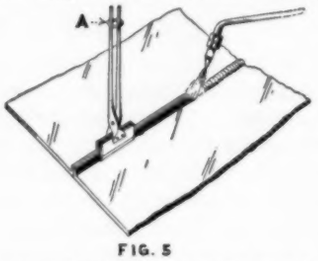


FIG. 5

Fig. 4—Flanged seam. Fig. 5—Manipulating the torch

it is often necessary to first wash them with a piece of waste soaked in kerosene to which a little machine oil has been added, so as to remove the greater part of the greasy matter.

To completely remove the grease, it is preferable to slowly and carefully heat the casting with an atmospheric blowpipe or blowlamp flame until the oil is burned from the surface. In aluminum-alloy castings, oily and fatty matters are often retained by the metal in considerable quantities, owing to its porosity. Should a weld be effected before the oil is expelled, the oil will carbonize and adhere to the edges of the work, thus impeding coherence of the two surfaces to be united. A stiff-bristled, steel-wire brush is a very useful tool for removing oxide and dirt from aluminum castings, as also are old files when ground to a chisel edge (the angle should not be less than 90 deg.) and used as scrapers.

It is of the utmost importance that suitable goggles should be worn by the operator when executing welds by the oxyacetylene process, to avoid serious injury to the eyesight. Light-green tinted glass is generally used when welding aluminum. Goggles should be light and easily adjusted, and the frames should conform to the contour of the face so that the eyes will be protected from dust, splashes of metal or particles of oxide.

Beveling the edges of sheet aluminum preparatory to welding, is not necessary in metal under a thickness of $\frac{1}{8}$ in. The type of welded joint commonly used is the familiar buttweld as shown in Fig. 2. In metal from $\frac{1}{8}$ to $\frac{3}{16}$ in. in thickness, the edges should be beveled to an angle of 30 to 35 deg., so as to obtain a V having an included angle of 60 to 70 deg. For thicknesses over $\frac{3}{16}$ in. the edges should be beveled to an angle of 45 deg., or an included angle of 90 deg., as shown in Fig. 3, so as to enable the welding flame to come in direct contact with the whole of the surface to be united. Expert welders can oftentimes execute welds in sheet aluminum up to $\frac{3}{8}$ in. thick without beveling, but it should be stated that this is purely a matter of individual skill, and the less competent welders should always bevel the edges of sheet aluminum exceeding $\frac{1}{8}$ in. in thickness.

In repetitive work on thin sheets, up to, say, a maximum of $\frac{1}{16}$ in. thick, the edges of the sheet may be flanged at right angles, as shown in Fig. 4, the flanges having a height of $\frac{1}{16}$ to $\frac{1}{8}$ in., varying with the thickness. As a general rule, the height of the flange varies from once and a half to twice the thickness of the sheets. The two flanged edges should be adjusted so that they touch for the whole length. The manipulation of the welding flame to both edges (see Fig. 5) serves to simultaneously fuse the one with the other, effectively uniting the two sheets, and in this manner, the flanges being melted down, replace the welding rod usually used in thick sections. By this method, it will be seen that heterogeneous metal does not enter the weld, the joint being entirely composed of metal identical with the surfaces to be welded.

Before proceeding to make a long weld, it is sometimes advisable to first "tack" the flanged pieces by fusing the edges of the flange together at intervals of 4 to 6 in. This method prevents the sheets from getting out of alignment and overlapping or spreading at the end farthest away from the point of welding, due to the effects of expansion and contraction. In some cases, the flanges may be satisfactorily clamped with tongs as shown in Fig. 5. In production work, the tongs are usually operated by a helper who grips the metal a short distance ahead of the weld and shifts the tongs along as the weld progresses. When the welded joints are of a great length, a number of tongs may be used, being held in position by the locking ring which is shown around the handle at *A*. Should the work be unsuitable for flanging, as is sometimes the case on intricate shapes, the edges of the metal may be simply butted together, the use of a welding strip or rod then being necessary. Another method of preventing overlapping of the sheets, in the case of longitudinal joints in cylindrical tanks, is to insert a wedge of appropriate size between the edges at some little distance from the point of welding, moving the wedge as the weld progresses. This method is shown in Fig. 6. The rule is to set the edges out of parallel about $\frac{1}{4}$ in. to the foot. Thus a longitudinal joint 6 ft. long should be tacked closely together at one end, while the edges of the other end stand apart about $1\frac{1}{2}$ in. An allowance should be made for expansion and contraction.

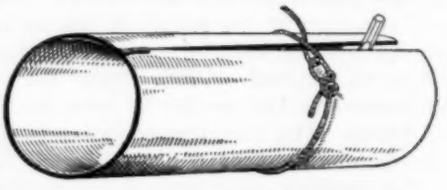


Fig. 6—Wedge placed to prevent overlapping

In welding thin, sheet aluminum, the effects of expansion and contraction are usually provided for by flanging the edges; by tacking; or by the use of jigs to hold the work in alignment. When welding sheet aluminum $\frac{1}{16}$ to $\frac{1}{4}$ in. and upwards in thickness, it is advantageous not to push the sheets or plates together completely, because the intense heat of the torch flame causes the metal to expand considerably, and if the sheets touch each other completely, the passage of molten metal into the joint is impeded by overlapping of the sheets.

"Tacking" the sheets at intervals, as shown in Fig. 7, prevents this overlapping, but has the disadvantage

of causing buckling or warping. Warpage can usually be eliminated, however, by judicious hammering or rolling the sheets after welding. Doubtlessly, the better method is to diverge the sheets as shown in Fig. 8. This method is analogous to the method described above, when welding longitudinal joints or seams in cylindrical tank manufacture.

Another method to compensate for the excessive expansion and contraction of sheet aluminum during the welding operation, is to employ heat-conducting blocks. Preferably, the blocks or bars should be of

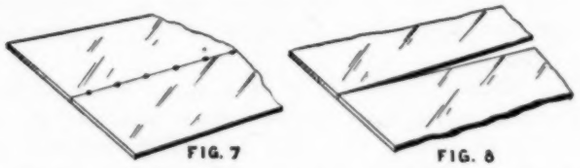


Fig. 7—Sheets tacked at intervals. Fig. 8—Sheets with edges diverged

copper, and of substantial thickness, so that the heat, which would otherwise expand and distort the sheets, may be readily absorbed by the blocks. The sheets to be welded are placed in position on a sheet of asbestos, which in turn is placed on a firebrick, iron plate, or other similar material. The conducting blocks or bars are placed on the sheets on each side of the seam. The blocks should be regarded as part of the welding equipment. They should be perfectly smooth and conform directly with the work, so that metallic contact may be obtained all over the surfaces that come next to the aluminum. In the absence of copper, substantial brass, iron or steel blocks may be used satisfactorily.

(To be concluded)

Standardization of Drawing Room Practice

The American Engineering Standards Committee announces the launching of a comprehensive program of standardization of drafting room practice. This action follows the unanimous recommendation of a representative conference held in December at which professional and trade associations, large engineering schools, and manufacturing concerns interested in drawings for shop and other work were represented.

One of the important items to be considered is the series of sizes for drawings. Other items on the program are: classification of and corresponding nomenclature for drawings in accordance with their purpose; method of representation of the subject, such as the arrangement of views and sections; indication of dimensions and tolerances; indication of surface, or finish; symbols representing in a diagramatical form certain elements of construction, such as threaded parts; the arrangement of drawings as to borderline and title; kind and size of lettering; figures and symbols; scales of reduction or enlargement; drafting equipment; and tools and specifications for materials to be used for drawings.

The work will be carried out by a large sectional committee on which all interested groups will be represented, under the sponsorship of the American Society of Mechanical Engineers and the Society for the Promotion of Engineering Education.

A Code of Ethics for Buyers—Discussion

By F. P. Terry

I read with interest the editorial on page 638, Vol. 63, of the *American Machinist*, and would recommend the remarks to all buyers and makers of machine tools. Many of them are probably guilty of greater indiscretions than the case mentioned in the editorial.

Quite recently the writer was shown a new machine tool that appeared to have an attachment similar to one manufactured by another firm. When this was mentioned to the manager, he replied, "Oh yes! You are correct. We got quotations from the company who make the attachment and also from Blanks who were somewhat cheaper. I offered the order to Blanks upon the condition that they put this attachment on their machine without extra cost and they 'took the bait.'"

Although I considered this transaction to be very little better than stealing and receiving, and said so, this manager seemed to think that he had done a clever piece of business for his firm and for himself. But in reality he now has an inferior machine with a substitute attachment that is not standardized as part of this particular machine and which may, in the end, add a considerable amount to the cost of the machine if anything should go wrong, while, on the other hand, had he purchased the standard machine from the makers who have equipped it with their own attachment, such trouble would not arise.

No one desires to blame the machine shop manager for getting as much as possible for his firm out of the money invested, or the machine tool maker for securing all the orders that he can. But, in this case, neither the maker nor the buyer possesses a code of ethics that is a true one and a credit to the trade.

Some employers may admire this sort of thing, but the great majority of them would not encourage such a practice on the part of the manager or recommend the machine tool firm that will steal another firm's ideas. Both are guilty of the worst kind of duplicity.

During the past thirty years, the writer has taken part in the purchase of many thousands of dollars worth of machine tools and he has studied the *American Machinist* and other publications in order to find out, as far as possible, who are the originators of particular designs. When desiring any equipment, he has endeavored to see that all orders with which he is connected go to the original firms and not to someone else who offers a copy for a few dollars less, nor would he think of asking any maker to put on a machine such attachments as were introduced by someone else. Should the builder offer to do such a thing, friendly business would cease at once.

As mentioned in the editorial cited, a code of ethics is needed by both sides so that all buying and selling can face the limelight of straight business and so that no one will have anything to hide.

In one large plant the men work from 7 a.m. to 3:30 p.m., taking a half hour for lunch. This gives a 48-hour week and leaves a lot of daylight for gardening or fixing up around the house. Some of the younger men spend part of it studying in the shop school. Classes start at 3:40 and last an hour. Nearly 500 attended and 250 certificates were issued. It's a plan worth thinking over.

Book Reviews

Health Maintenance in Industry. By J. D. Hackett. Four hundred and seventy-seven pages, 6x9 in., flexible leather binding. Tables, forms, and a few illustrations. Indexed. Published by the A. W. Shaw Co., Cass, Huron and Erie Sts., Chicago, Ill. Price $6.

A convincing argument in favor of the adoption of medical departments by individual concerns in industry and a thorough treatise on the work of the medical and hygiene departments.

The book is entirely practical. It furnishes ninety-two tables of information directly applicable by the medical and personnel departments and illustrates a number of forms that are finding daily application.

The main subjects of the twenty-seven chapters are health maintenance; the surgical department; plant hygiene; and plant sanitation.

"Health Maintenance in Industry" will prove to be a great help to the conscientious manager who is always searching for what is best for the welfare of his plant and business. It will also be of great assistance to the manager and the medical and personnel staffs where industrial hygiene is already being practiced.

Mainsprings of Men. By Whiting Williams. Three hundred and eight pages, 5x8 in., cloth boards. Illustrated. Published by Charles Scribner's Sons, 48th St. and Fifth Ave., New York City. Price $2.

No mere theorizing is "Mainsprings of Men." Whiting Williams actually understands the workers' feelings. During several years of "overalls" experience in steel mills, mines and shops in this country and abroad Mr. Williams has acquired knowledge that has enabled him to write an exceedingly impressive book on the psychology of the worker.

The book is divided into chapters, in the usual manner. There are thirteen of them. However, irrespective of their number, they are a development of five outstanding impressions, listed by the author as acquired during his years in overalls. Those impressions are:

"1. The astonishing consequences which follow in the lives of millions from the restrictions of their material and their dollars-and-cents conditions—consequences physiological, intellectual, emotional, and spiritual.

"2. The surprising vastness of the gap which everywhere among the workers separates the holder of a 'swell' job from the holder of a 'bum' one, and most of all divides the possessor of *any* job at all from the luckless vagrant who possesses none and knows not where to find one.

"3. The amazing ignorance, on the part of employer and employee, of each other's deeper purposes and desires—the incredible ease and certainty with which each of these groups proceeds to justify to itself its own view-point regarding the other. So far from caring to indulge in mutual study, each appears so often to feel that it already knows too much about the other!

"4. The unbelievable importance of the worker's feelings and experiences rather than his logic or reason as a factor in all his view-points and attitudes.

"5. The unity of life and labor—the complete impossibility of walling off the factory from the home, the worker from the citizen, of dividing the hankerings of a man's working hours off from those of his hours of leisure."

Each chapter is followed by a set of problems and by a list of references that are of great value to the student of personnel matters. Problems and references may be ignored; doing so does not interfere with the remainder of the book, which is so well written and so admirably presented that it is far more absorbing than the average romance.

The Industrial Museum. By Charles R. Richards. One hundred seventeen pages, 6x9 in. Published by the Macmillan Co., New York. Illustrated. Price $3.

This volume is the result of a study made by the author in behalf of the American Association of Museums in 1923-24 in which he visited museums in England, Denmark, Sweden, Germany, Austria, Hungary, Czecho-Slovakia, Switzerland, France, Belgium and Holland. Both industrial museums, and museums of industrial art were covered in the survey.

The book makes a plea for the establishment of industrial museums in America, such as that for which the National Museum of Engineering and Industry is striving. A typical plan for such museums is discussed, the object borne in mind being to secure maximum educational value at a reasonable cost. The Science Museum in London, as well as the three European Museums, at Munich, Paris and Vienna are described, and illustrated. This, we understand, is to be followed by a second volume, concluding the results of the survey.

Income Tax Procedure, 1926 Manual. By William B. Castenholz. One hundred and twenty-six pages, 8½x11 in. Bound in flexible leather. Published by the La Salle Extension University, Chicago, Ill. Price $3.

The 1926 manual on income tax procedure deals with the problems and features of the income tax laws, which concern the majority of taxpayers, whether corporate or individual. The subjects included in the work are: income tax legislation in the United States, individual returns, partnership and fiduciary returns, corporation returns, inventories, general and administrative provisions. A list of government forms for use in connection with income tax returns, with their corresponding numbers is given.

The material is systematically and carefully organized, the first chapter being an historical and chronologically arranged statement of the laws affecting income, which are based on the constitutional amendment ratified in 1913. The explanations are as brief and to the point as practicable and they are clearly made. Examples and illustrations of problems raised throughout the work are worked out for study. All fundamental terms are clearly defined so that a previous familiarity with the subject is not necessary.

The book will be found a very useful one to those connected with this work, since it covers the field in a very thorough and satisfactory manner.

The estate of a prominent manufacturer of matches, who died a few years ago, has just been settled. Among the securities was a large block of stock in a fire extinguisher company. He evidently expected to get it both coming and going.

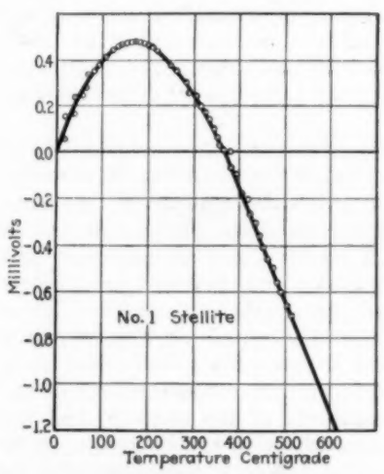
The Measurement of Cutting Temperatures

By E. G. Herbert
Director, Edward G. Herbert, Ltd. Manchester, England

Study of continuous and instantaneous temperatures generated by cutting tools — Galvanometer used in conjunction with a tool-work thermocouple

MOST of the operations of the engineer's workshop resolve themselves into cutting or otherwise deforming metals with hard steel tools, and all such operations generate heat. A knowledge of the actual temperatures is of twofold importance. The temperature may, if high enough, affect the hardness of the tool, and for this reason it is important to know both the temperature involved and the heat-resisting properties of the tool—its hot hardness. The temperature may also affect the various physical properties which constitute machinability in the work material, whence it is important to know the temperatures to which that material is liable to be subjected in working, and its properties at those temperatures.

Owing to the impossibility of introducing a pyrometer at the actual point where heat is generated in cutting, the plan has been adopted of using the tool itself and the work material as the two elements of a thermocouple and measuring the temperature at their surface of contact by the electromotive force generated in this "tool-work thermocouple." In the experiments to be described the tool used when cutting steel was generally of stellite, which was chosen for this purpose because it is a hard non-ferrous alloy capable of withstanding very high temperatures. Ordinary steel tools were used when cutting non-ferrous metals, and also in some cases when cutting mild steel, the electromotive force generated in a tool-steel, mild-steel couple being quite sufficient for the purposes of temperature measurement.



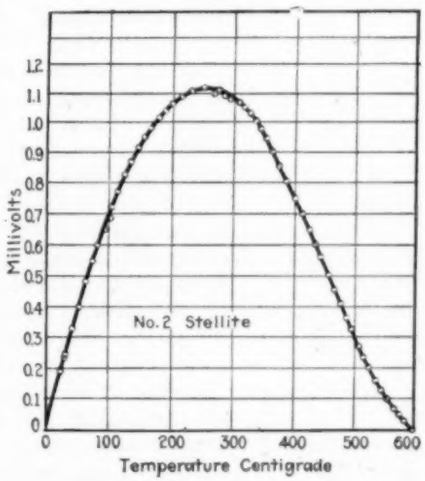


Fig. 1—Calibration curve of No. 1 stellite and steel test tube couple.
Fig. 2—Calibration curve of No. 2 stellite and mild steel couple

The procedure consisted in insulating the tool from the slide rest or tool box of the machine tool, strips of mica being used for this purpose. One terminal of a unipivot millivoltmeter was then connected to the insulated tool, and the other terminal to the machine.

In many cases it was desired to reproduce normal working conditions in which a cooling liquid is employed. No difficulty was experienced when using oil, but when the coolant employed was either water or one of the common cutting compounds in aqueous solution, a considerable galvanic current was set up. This was avoided by smearing the tool thickly with tallow. The point of the tool was of course bare, but no galvanic effect was produced.

In order to convert the readings of the voltmeter into temperatures it was necessary to calibrate a couple composed of the tool and a piece of the work material. These were either clamped or welded together and placed in a tubular electric furnace with a standard iron-constantan thermocouple, the latter being connected to an indicator graduated in degrees Centigrade. Calibration was made with the actual tool used in cutting, a long stellite extension being fixed to it and carried into a vessel containing melting ice for the cold junction.

Two grades of stellite were used in the experiments. No. 1 grade, being harder and rather more brittle, was used for the light cuts taken on the tool-steel testing machine, while No. 2 stellite, less hard and less brittle, was used for heavy cutting on the lathe and other machines.

In Fig. 1 is shown the calibration curve obtained from No. 1 stellite and a standard steel test tube as used on the tool-steel testing machine, and in Fig. 2 that given by the No. 2 stellite tool and a piece of the mild steel bar used in the cutting tests.

Both the temperature-voltage curves are of parabolic form, with reversal of polarity at 370° and 600° C. respectively. It might at first sight appear unfortunate that the calibration curve should take this form an ac-

Paper to be presented at the annual general meeting, Institution of Mechanical Engineers, London, England, Feb. 19, 1926. This article is the first part of the paper. The second part will appear in an early issue.

count of a certain indefiniteness in the voltage-temperature indications near the apex of the curve, and because any given positive voltage may correspond to either of two temperatures. In experience it was found that little ambiguity arose, while the parabolic curve has certain advantages which will be explained later.

It should be noted that the temperatures in the diagram are *differences* of temperature between the hot and cold junctions of the calibrated couple. The voltages obtained in the cutting tests likewise indicate the difference between the temperature at the tool point and the temperature at the cold junction, which is generally room temperature. To obtain the actual temperature at the tool point, it is therefore necessary to add the room temperature, say 20° C., to the temperature obtained from the diagram.

In Fig. 3 is shown the speed-temperature diagram obtained from a No. 1 stellite tool cutting under standard conditions on the tool-steel testing machine, dry, with oil, and with water. The cut was made on the end of a standard steel tube ¾ inch diameter, ⅝ inch bore, the traverse of the tube being 0.0012 inch per revolution. The tool had no top rake and 20° clearance. The sudden increase of temperature in the water curve at about 130 feet per minute may be due to centrifugal action throwing the cooling water off the tube when it was running at high speeds.

In Figs. 4 and 5 are shown the temperatures generated by a No. 2 stellite tool turning a mild steel bar 2½-inch diameter on a No. 13 bar lathe by Alfred Herbert, Ltd. The tensile strength of the mild steel was 29.7 tons per square inch. The depth of cut was in all cases

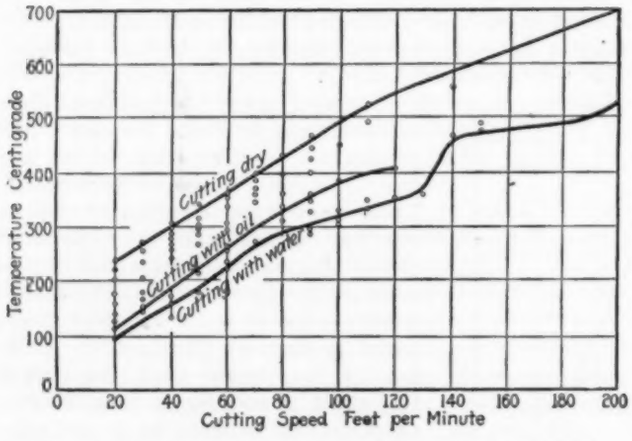


Fig. 3—Temperatures generated on the tool steel testing machine

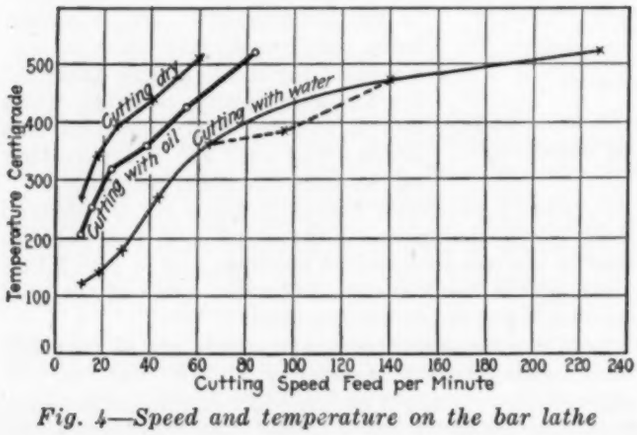


Fig. 4—Speed and temperature on the bar lathe

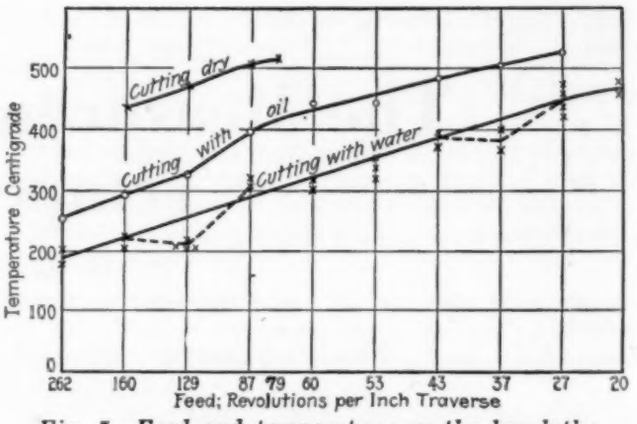


Fig. 5—Feed and temperature on the bar lathe

⅜ inch. The stellite knife tool had top rake 27°, clearance 6°. Tests were made dry, with machine oil, and with water containing a soluble cutting compound. The tests in Fig. 4 were made with a fixed feed of 43 revolutions per inch traverse, and at various speeds. Tests in Fig. 5 were made at fixed speeds of 58.5 feet per minute and the feed was varied.

Instantaneous and Fluctuating Temperatures

The method of measuring cutting temperatures which has been described is easily applicable to any cutting process in which the temperature is reasonably constant, or subject only to such slow variations as may be caused by the gradual heating up of the tool and the work as the cutting proceeds. In many of the cutting operations of the engineer's workshop these conditions do not apply. The temperature is subject to periodic variations, sometimes of a rapid and complicated character, while in certain classes of operations such as punching and shearing, press work generally, and all those processes in which blows are employed, the rise and fall of temperature may occupy a very small fraction of a second. In such cases the voltage generated by the tool-work thermocouple cannot be measured with a voltmeter of the ordinary type, owing to the inertia of the moving coil and needle.

To overcome this difficulty recourse was had to the string galvanometer invented by Professor Einthoven, of Leiden. In this instrument an exceedingly thin fiber of glass, coated with silver to render it a conductor, is stretched in the field of a powerful electro-magnet, and by suitable optical arrangements the vertical shadow of the fiber, magnified 600 times, is projected on a screen bearing a horizontal graduated scale. When a small current is caused to pass along the fiber, it is deflected by an amount depending on the strength of the magnetic field, the magnitude of the current, and the tension of the fiber. The deflection can be measured by observing the movement of the magnified image across the scale, and by applying to the fibre a standard voltage and suitably adusting its tension an accurate calibration can be made. In the experiments to be described the diameter of the fiber was 0.007 mm. The standard voltage used in calibrating was 2 millivolts, and the tension was so adjusted that the image was deflected 1 cm. per millivolt or 2 cm. per millivolt according to the character of the temperature variation to be measured.

The movements of the fiber are often too rapid to be followed by the eye, and in order to remove difficulties arising from this source, and at the same time to secure

a permanent record, a narrow slit is cut in the screen on which the image of the fiber is projected, and arrangements are made whereby a photographic plate can be caused to fall behind the slit at a predetermined rate controlled by an oil dash-pot. A cylindrical lens, on which are inscribed graduation lines corresponding to those on the screen, serves to concentrate the light on the slit, while the graduations on the lens are reproduced in the form of a series of parallel lines on the falling plate, thus constituting a voltage scale in the record. Finally, the arm of a metronome is caused to pass across and momentarily to obscure the beam of light at intervals of 1 second or of ½ second, with the result that parallel time lines are produced on the photographic plate corresponding to the cutting off of the light by the metronome. The shadow of the fiber crossing the slit traces an unexposed line on the plate, and any movements of the fiber due to fluctuations in the current passing through it appear as undulations in this line. The whole apparatus is stationed in a convenient situation and is connected by a pair of wires and a telephone to any part of the works where temperatures are to be measured.

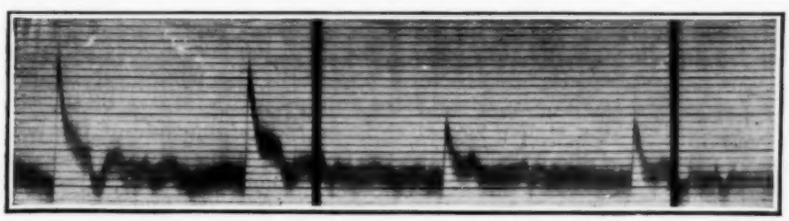
The combination of the tool-work thermo-couple with the string galvanometer is believed to constitute a very powerful instrument of research. It is new, and the technique of its use is still undergoing development. The examples which follow are designed to illustrate the capabilities of the method and the character of the records produced.

In Fig. 6 is shown the thermograph produced by chipping a mild steel bar with a chisel of No. 2 stellite. The temperature rose in 1/160th second to a maximum of 160 deg. C. and fell in 1/9th second to normal.

In Fig. 7 the temperature generated between the hammer and the head of the chisel is indicated. In this case a hammer was made of the mild steel used in the calibration Fig. 2. The temperature rose in 1/300th second to a maximum of 74 deg. C. and fell in 1/60th second to normal. A similar diagram was made with a hard steel hammer and the stellite chisel. The voltage was rather less (the couple was not calibrated), the maximum being attained in 1/500th second and the fall occupying 1/100th second.

The thermograph in Fig. 8 was taken from the edge of a chisel when file cutting by hand. The file blank was of the calibrated mild steel and the chisel of stellite.

It will be observed that in this case each blow produces a voltage curve having two peaks. To explain this it is necessary to refer to the calibration curve Fig. 2. It is evident that in order that the voltage may arrive at any point on the right hand or falling branch of the calibration curve it must first pass through the maximum corresponding to the apex of the parabola. In the thermograph Fig. 8 the left-hand peak indicates the passage of the voltage over the apex of the parabola



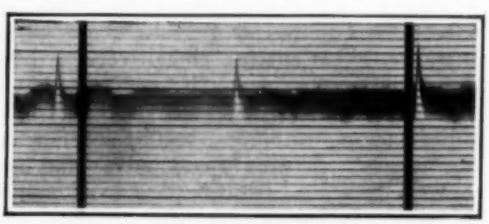
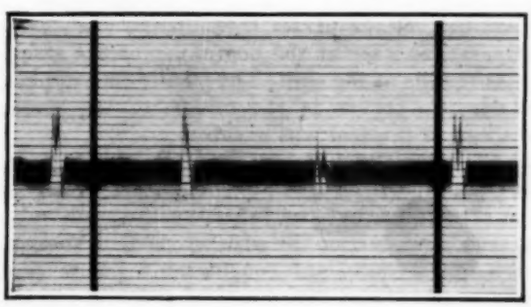


Fig. 6—Chipping mild steel with stellite chisel (20 mm. = 1 mv. 1 second time marks, 160 deg. C. maximum temperature). *Fig. 7—Temperature between hammer and head of chisel,* (20 mm. = 1 mv. 1 second time marks, 74 deg. C. maximum temperature)



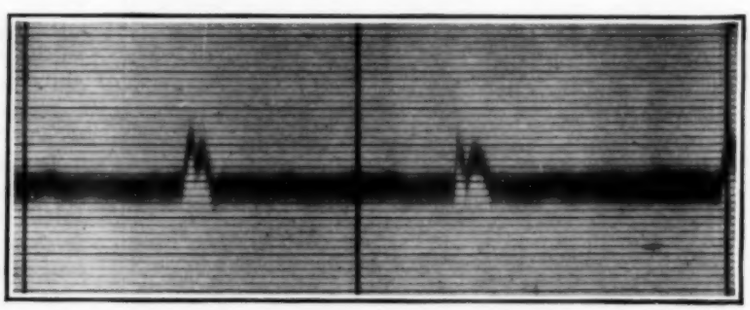
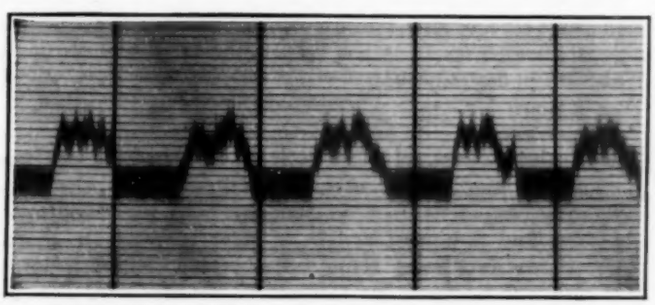


Fig. 8—File cutting (10 mm. = 1 mv. 1 second time marks, 490 deg. C. maximum temperature). *Fig. 9—Same as Fig. 8, but with ½ sec. time marks* (10 mm. = 1 mv.)



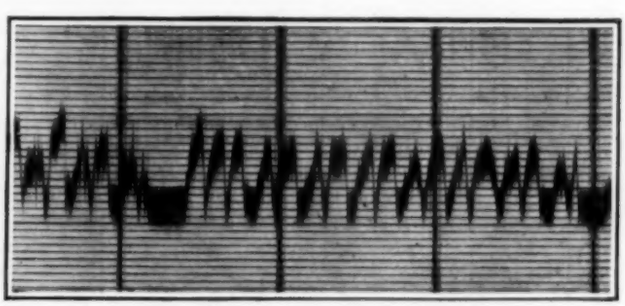


Fig. 10—Filing a bronze bar (20 mm. = 1 mv. 1 second time marks, 90 deg. C. maximum temperature)
Fig. 11—Scraping a steel surface (10 mm. = 1 mv. 1 second time marks, 260 deg. C. maximum temperature)

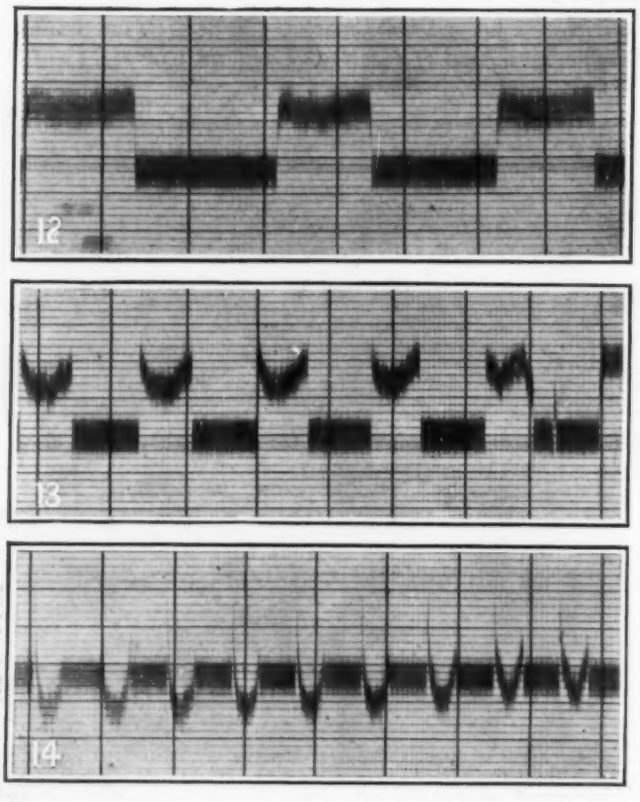
(280 deg. C.) and down to the value corresponding to the maximum temperature on the falling branch of the curve. The lowest point between the two peaks indicates the maximum temperature, in this case 490 deg. C. When the force of the blow is expended, the temperature falls, and the voltage retraces its course over the apex of the parabola, thus forming the second peak. The whole of these changes take place and are recorded in about 1/25th second. In Fig. 9 two blows of the file cutting chisel are recorded on a rapidly falling plate, the interval between the time lines being half a second, and the heating and cooling parabolas are rather more clearly seen.

Attention is drawn to the third record from the left in Fig. 8. In this case the two peaks occur, but the maximum voltage and also the minimum voltage between the peaks are abnormally low. As the file cutting was not done by an expert it is not surprising that there should be variation in the force and character of the blows, but the particular form taken by the variation in the voltage curves calls for comment.

When a thermocouple is placed in a furnace the whole surface of contact between the two metals is at approximately uniform temperature, and the voltage generated by the couple is a measure of that temperature. But when the thermocouple consists of the cutting edge of a tool and the portion of metal which it is cutting, there is a possibility of considerable variation of temperature at different points in the surface of contact. If, for instance, a file cutting chisel were so held as to cut a groove of varying depth, it is evident that the portion of the edge which penetrated deepest would generate a higher temperature than that portion which penetrated less deeply. In such a case we should have at a given moment different voltages generated at different points along the edge of the chisel, and the highest voltage would be shunted or partially short circuited by those portions of the couple in which the voltage was momentarily less, with the result that current would circulate within the couple and the current passing through the galvanometer would be reduced.

This matter of partial short circuiting is of extreme importance in the interpretation of voltage curves from cutting tools different parts of whose cutting edges may be at a given instant at different temperatures. It is here that the advantage of the parabolic voltage curve becomes apparent. A thermograph in which the peak voltage is considerably below that obtained in calibration should lead to an examination of the cutting conditions, and the elimination of any cause (such as clogging by chips, rubbing on the tool of any portion of the chip which has been separated and partially cooled, scraping of the work by any portion of the tool edge not engaged in actual cutting, etc.) which might cause a partial short circuiting of the couple.

In Figs. 10 and 11 the effects of filing and scraping are shown. An ordinary file was used on an aluminum bronze bar and these were separately calibrated. The stellite scraper and mild steel surface were those calibrated in Fig. 2.



Figs. 12, 13, 14—Shaping mild steel at 20 strokes, 38 strokes, and 68 strokes per minute (10 mm. = 1 mv. 1 second time marks)

Shaping Mild Steel

The records shown in Figs. 12, 13, and 14 were produced by shaping a mild steel bar 9⅜ in. long with the stellite tool at 20, 38, and 68 strokes per minute respectively. In Fig. 12 the voltage in the center of the cutting stroke was slightly on the falling side of the peak of the parabola, the temperature being 370 deg. C. The shaper had a quick-return motion, but the cutting time is seen to be actually less than the idle time, which latter included not only the whole of the return stroke, but also those periods at the beginning and end of the cutting stroke when the tool was not in contact with the work.

In Fig. 13 the voltage passes through the peak value as the temperature rises at the beginning of the stroke and again as it falls at the end. The maximum temperature, 440 deg. C., occurs in the middle of the stroke when the speed of the tool was greatest.

In Fig. 14 a very high temperature was generated. The plate was not moving fast enough to show the initial rise of voltage, but the fall from the peak value is clearly seen, and during the greater part of the cutting stroke the voltage was considerably below zero, that is to say there was a reversal of polarity, which, as can be seen from the calibration curve Fig. 2 (from the identical tool and bar) occurs at 600 deg. C. Facilities were not available for continuing the calibration to the value of —0.4 millivolt, and the maximum temperature in Fig. 14 is not known, but it must have been above 700 deg. C.

It is generally a mistake to say that any method is best for all cases. In fact it isn't easy to be dead sure it is best for even one case. They tell us that arc welding cannot be used on cast iron without studding—yet we find it being used in a number of repair shops. On the other hand some tell us that flame welding should not be used on locomotive frame jobs, but we find many using it satisfactorily. As a matter of fact both methods have their place. The task is to find which gives better results under given conditions.

New Fields for Modern Management

By Wallace Clark
Consulting Management Engineer

Contrast between old-fashioned and modern shops —Development of sales quotas and various types of budgets—A typical administrative control chart

TO REALIZE what has been accomplished by applying management science to production, compare the factory of twenty years ago with a modern plant. Materials used to stand on the floors of shops for months at a time; in fact it was not unusual to find orders which had been in a plant for over two years. Inventories were unbalanced. In one case 88 years' supply of one item was found in stock, while hundreds of other items were entirely out of stock. The foreman usually had to hire his own help, keep his own stock of materials and supplies, repair his own machines and keep whatever records the office asked. Often he was so busy with these things that he had no time for his real job of getting production. "Passing the buck" was another characteristic of old-fashioned management.

In the well-organized plant today, however, one does not see such confusion. Before an order is issued to the shop the necessary time is reserved on the various machines, so that when the material is released from the storerooms it moves at a steady rate through the plant. In one shop recently the manufacturing time was cut from six months to six weeks, which reduced the investment in work in process and in inventories by $700,000.

Definite tasks are now set for workmen and the responsibilities of all the members of the management are clearly defined, and, as a result, in place of the old "buck passing" shops we have smoothly running organizations moving at top speed.

These methods of production management, originated by F. W. Taylor, simplified and humanized by H. L. Gantt, and carried to their highest development within the last few years, have been to a great extent responsible for the increase in productive capacity of this country.

Scientific Management for the Sales Department

The first step of this scientific or modern type of management outside of production was the application of the task idea to sales organizations, usually referred to as quotas for salesmen. These quotas have done much to stimulate salesmen and stabilize their jobs, for they are no longer judged by a hit-or-miss method, but are expected to make good on a prearranged basis. Quotas have been worked out with increasing accuracy and at the present time are a feature of almost every well-operated sales organization.

This new type of management was next applied to the problems of offices. As a result most of our large companies have changed from the departmentalized office to the centralized type, that is, instead of being composed of many independent departments, each complete in itself, the office is now made up of central mail, filing, stenographic, purchasing, order and statistical departments, which are organized to serve those departments which deal directly with sources of supply or with the public.

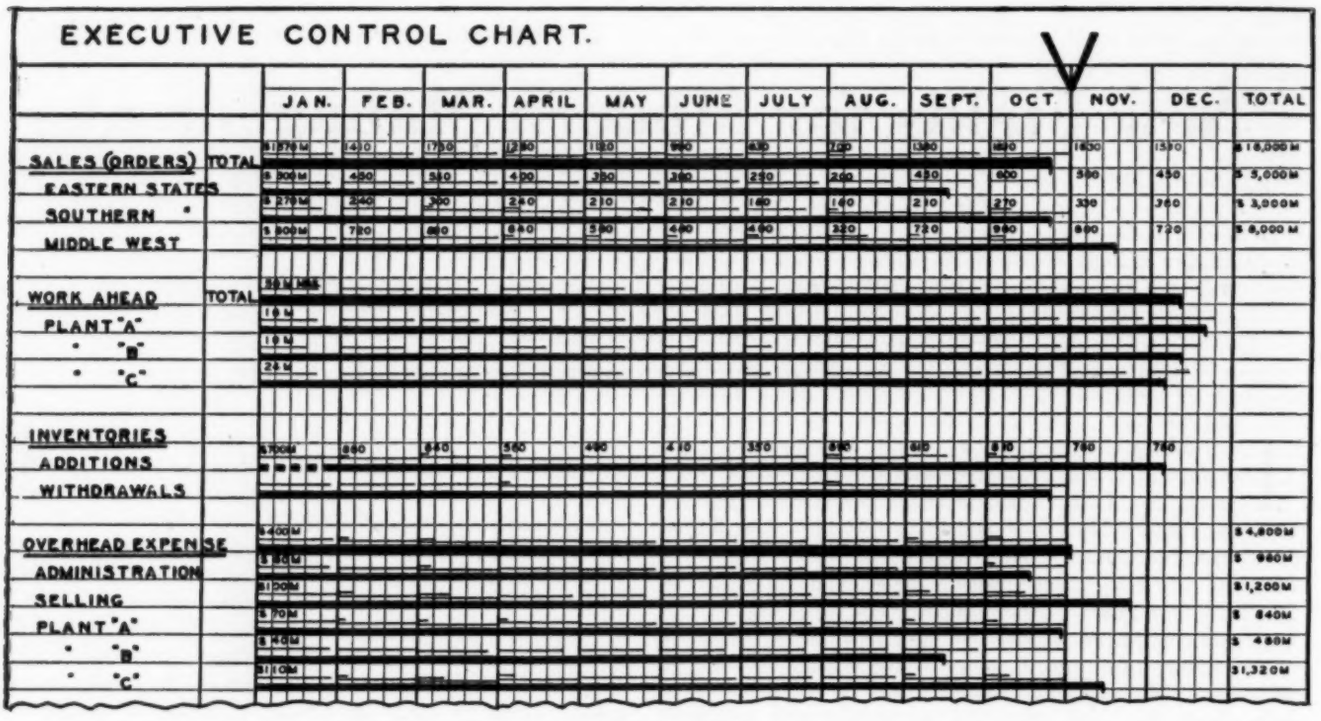
This centralized type of office organization has resulted from the application of the principles of division of labor and mass production to the work done in offices. It has brought about great savings; but even more important have been the improvements in accuracy and speed. The product of offices consists of pieces of paper bearing information and, where modern management is found, there is as steady a flow of papers through the office as there is of materials through the up-to-date shop.

Budgeting and Financial Control

During the last three or four years the financial side of business has adapted to its own needs the methods of planning which have been carried so far in production. As a result we now have budgets for expenses, payroll budgets, and financial budgets. Due to this careful planning of finances, many a firm which seemed headed for the rocks has been safely steered into smooth waters.

The phase of management which has recently been occupying the attention of engineers is the general control of a business organization. Some years ago there was a plant in New York State where the production had been so speeded up that the factory had to be shut down for a whole year before the stock on hand could be sold. There was another company in which the sales organization was moving at such speed that the product was sold 18 months in advance on a rising market. As a result the customers had all the advantage of the market and the manufacturer none. Dozens of cases could be cited in which the finances of a company have not kept pace with either the manufacturing or the selling. It is this problem of co-ordinating all of the various activities of a modern corporation that engineers are now solving by applying to it the technic which they have developed in production and sales management.

The executive control chart shown is an illustration of this technic. The company for which this chart was prepared operates three manufacturing plants and it is necessary for the chief executive to keep himself advised as to all the varied activities of these plants. First of all, he wants to know how his sales compare with the quotas which have been worked out at the beginning of the year. Figures at the left of the monthly spaces indicate the quotas for the various months, amounting to an annual total of $16,000,000.



This chart is used in the control of a company which manufactures three products. Figures at left of monthly columns represent the quota, schedule or budget for the month. Figures in last column headed "total" indicate cumulative schedule. Light lines represent actual sales; expressed in a ratio, the light line is to the monthly space as the actual sales are to the quota. Heavy lines show actual performance to date.

The "V" at the top of sheet indicates that chart was photographed after the October records were entered. If a heavy line ends to the right or left of the "V," the activity has exceeded or fallen short of the standard.

The light lines show the ratio of the actual sales to the quotas, and the heavy lines indicate the cumulative actual sales.

The "V" at the top shows that the chart was photographed at the end of October. If the actual sales had kept pace with the quotas, the heavy line would end directly under the "V." The fact that it ends to the left indicates that the sales fell short of the quotas. The three lines which follow show that the Eastern territory was a month and a half behind its schedule, while the Middle West was half a month ahead.

The chief executive of this company also wants to keep informed as to the work ahead of his three plants, the inventories, and the overhead expenses. Additional items not shown in the figure keep the executive advised as to production costs, payroll, purchases, capital investments, collections and various other phases of his business.

It is easy to see that such a chart conserves the time of the chief executive and makes his work more effective, because his attention is directed to those things that are most in need of his special knowledge and experience.

Studying the Salesman's Job

There are several other fields of management which have only recently been opened up. One of these is the application of management technic to the problem of selling and distribution. The salesman long ago was given a quota to work toward, but there have been only a few serious attempts to study his job, to find out what type of selling he is fitted for, to simplify his routine work, and to remove the many obstacles which prevent him from concentrating his efforts on his real job of selling.

The same type of analytical study which has made possible such great strides in the handling of materials in manufacturing plants is now being applied to the distribution of goods. The number of times goods change hands is being reduced, operations are being combined and simplified, handling is being made more automatic, and wastes are being eliminated. This is resulting in better service to the public at a considerably lower cost.

Another phase of management ahead of us is the better understanding of men's minds. Management deals with materials, but only indirectly. It can not move materials or change their form until the minds of the workmen and management meet.

A Field for Psychology

The psychologists have already accomplished a great deal in selecting and training workers, in securing cooperation, and in bettering working conditions. However, little has as yet been done in the smaller group of men and women who compose the management. Here is a fertile field for the psychologist and psychiatrist, far more complex and difficult to study than workmen. The increased difficulty of the task is, however, compensated for by the fact that the influence of the phychologist will work through the management and reach a far greater number of people than could be dealt with directly.

The psychologist will render a valuable service by opening the minds of individuals in management to a better understanding of each other and of those under their control, and by removing mental obstacles which prevent them from executing their responsibilities. The psychologist, however, can not achieve his results without the engineer, who is best fitted to provide the plan of action and the technic showing the progress made

in carrying out the plan. Working together, the psychologist and the engineer will do much for management by applying their knowledge and technic to the individuals who actually operate industry and control the destinies of workmen.

Modern management is being applied to many unusual problems. There is a growing tendency among companies manufacturing similar products to co-operate and apply these modern methods to the control of their industry as a whole. Production, cost-finding, budgeting and control methods are sometimes installed in one plant which is used as a sample brick in extending the methods to the other plants.

Managers are finding that if they keep their doors closed to prevent information from getting out, they also prevent it from getting in. When uniform cost and production methods are used throughout an industry, a basis is provided for comparison. A study of instances where his costs differ from those of other plants, enables a manufacturer to discover wherein his policies are not in line with those of the other members of his industry.

This exchange of information in regard to costs leads to a similar exchange of data in regard to idleness of equipment and work ahead. A deliberate and intelligent control of pricing policies is thus substituted for the hit-or-miss setting of prices, because the individual manufacturer has before him a clear picture of the condition of the industry as a whole as well as of his own business. This in turn leads to co-operative purchasing of raw materials, fuel, supplies and other items; to standardization of quality; to reduction in the number of styles or varieties; and to dependable forecasts.

Straightening Out the Patent Office

An instance of the application of modern management to a government institution is the recent investigation of the Patent Office by a committee appointed by Mr. Hoover. The same technic used in manufacturing was applied, that is, a standard was set up and records were kept of the reasons why this standard could not be attained. In this way the obstacles which prevented the Patent Office from issuing valid patents within a reasonable time were discovered, classified and practical solutions were offered.

Within the last few years European nations have taken great interest in the management technic developed in this country; in fact, American methods of management are known everywhere for their directness, simplicity and speed.

To look back for a moment: modern management was developed in production organization. It made its way into the distributing end of business in the form of salesmen's quotas. It brought into offices division of labor and mass production or correspondence and clerical work. Next it appeared as the budgeting of finances and recently it has been applied to the executive control of a business corporation as a whole. It is now blazing a trail through selling and distributing organizations and in the future must tread the mazes of men's minds in order to develop more accurate methods of getting things done. This modern management is being applied to the co-ordination of entire industries, to the improvement of Government institutions and it is being recognized throughout the world as one of the great contributions of America to modern civilization.

Crankpin Design for Electric Locomotives—Discussion

By James D. Burby

REFERRING to the article on crankpin design on page 986 Vol. 62 of the *American Machinist* I offer the following discussion:

Assuming uniform distribution of stress at the surface of any transverse section of the pin fit, it can be shown that the unit stress at the surface is equal to the vertical load on the section divided by the projected area of the section.

This derivation is given on page 536, Lentweeler, "Elements of Machine Design."

We can therefore confine ourselves to the determination of the unit stress on the projected area produced by the vertical load. This can be derived by the same method as is used in finding the unit stress on a section of an eccentrically loaded short block.

In Fig. 1 let P be the rod thrust acting at a distance e from the center of gravity of the bearing. The load P is equilibrated by the central force $P' = P$ and the couple F, F. The unit stress due to the force P' is

$$\frac{P'}{DL} = \frac{P}{DL}$$

The maximum unit stress $S'c$, due to the moment $\frac{2FL}{3} = Pe$, occurs at the ends of the bearing and is equal to $\frac{Pec}{I}$ where $\frac{I}{C}$ is the section modulus of the projected area $\frac{DL'}{6}$. The combined maximum stress is Sc where

$$Sc = \frac{P}{DL} \pm \frac{6\,Pe}{DL'}$$

The greatest stress occurs where the stresses are cumulative. Reducing the equation, then, and using the nomenclature of the article under discussion.

The main rod thrust $Sc = \frac{Pm}{Dp}\left(\frac{L + 6m}{L'}\right)$

The side rod thrust $Sc = \frac{Ps}{Dp}\left(\frac{L + 6s}{L'}\right)$

To say that this bending formula is applied to that portion of the pin which is imbedded would be incorrect as the stress referred to in my formulas is derived from the formula $S = \frac{P}{A} \pm \frac{pec}{I}$ in which p is an eccentric load acting at a distance e from the center of gravity, in this case, the center of the area under stress. A and I are respectively the area and moment of inertia of the area and c is the distance from the neutral axis to the fibers whose stress is given by the formula.

This formula and its applications are discussed thoroughly on page 215, Boyd, "Strength of Materials."

In the case of the crankpin, the eccentric load is Pm referring to Fig. 5 of the original article. The distance m is the distance from the neutral axis $L/2$, is the distance to the fibers under stress, namely the fibers whose stress is to be determined.

Also the area and the moment of inertia are those of the projected area of the fit. Surely there can be no question as the applicability of this formula to the pin fit. The only question that could arise is whether we are justified in considering the projected area of the

fit as the area to be used in the formula, and further on I will show (not however by any original methods but by those that are accepted as correct) that this area is the correct one to take.

It will perhaps be better to show where I believe the

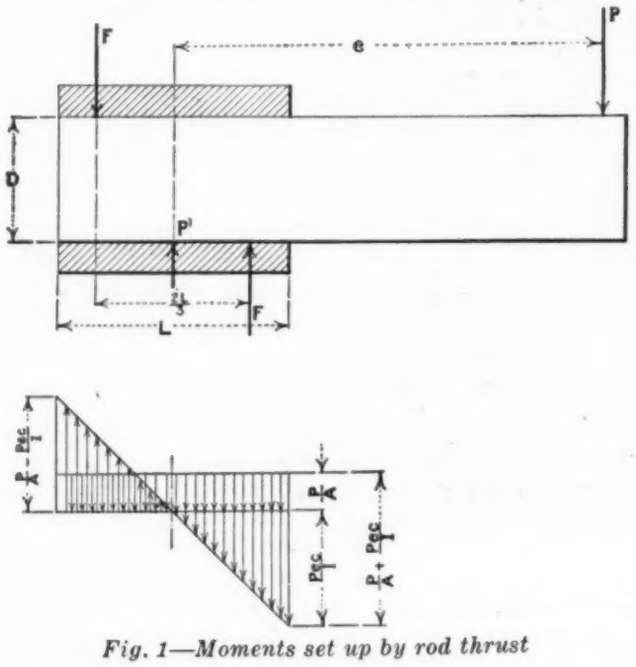


Fig. 1—Moments set up by rod thrust

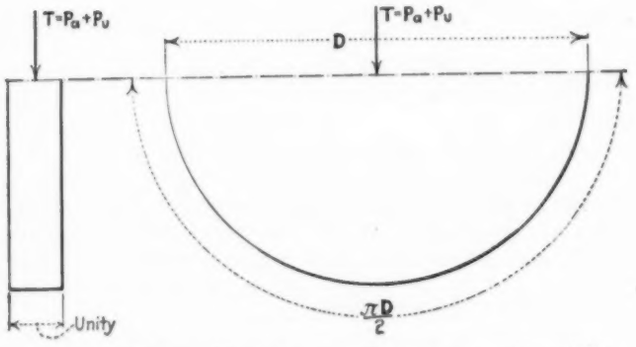


Fig. 2—The vertical force acting on a unit width

derivation of the formula given on page 991 is at fault. This formula is reproduced to assist the discussion,

$$T = Pa + Pu = \frac{P}{L} + \frac{6mP}{L^2} \quad (V)$$

It is my understanding that while the formula was originally described as representing "the total radial force at the extreme ends of the fit," the statement was corrected by Mr. Wood to read without the word "radial." He is therefore dealing with vertical forces and his equation (V) is an expression for the total "vertical" force acting on a section of the pin whose width, measured parallel to the length of the fit, i.e. parallel to L, is unity, as shown in Fig. 2.

Although Mr. Wood has derived this formula by a method which is not rigorous, I will accept it as correct, which it is. But in his next step, the derivation of an expression for the unit stress, he assumes that this force $Pa + Pu$, acting as shown in Fig. 2, is distributed over the area $\frac{\pi D}{2} \times 1$, since we are dealing with unit width.

Therefore, according to his derivation, the unit stress, $Sc = \frac{T}{\frac{\pi D}{2} \times 1}$ where T, of course equals $Pa + Pu = \frac{2T}{\pi D}$

$$\frac{2T}{\pi D} = \frac{2P}{\pi D}\left(\frac{L + 6m}{L^2}\right)$$

Let us now examine the correctness of this assumption. In Fig. 3, T is shown acting on the section of unit width, and is in equilibrium with such forces as F_1, F_2, etc. acting radially as shown. Since we are dealing with a tight fit the pressure is uniformly distributed, and if F_1 represents the resultant of all the forces acting on a strip of length ds and unit width, then what is true of this area will also be true of all such areas, and the sum of the vertical components of all such forces as F_1, F_2, etc. will equal T.

Let the uniform unit pressure, which also expresses the unit stress be Sc, then,

$$F_1 = Sc \times ds \times 1 = Sc \times r d\theta$$

where $ds \times 1$ is the area of the strip and ds equals $rd\theta$
Also the vertical component of F_1 is $F_1 \cos\theta$
Therefore, $F_{1V} = Sc \times r \times \cos\theta \times d\theta$
The sum of all these vertical forces is

$$\Sigma F_{1V} = \int_{-\frac{\pi}{2}}^{+\frac{\pi}{2}} Sc \times r \cos\theta \, d\theta$$

Therefore $T = \int_{-\frac{\pi}{2}}^{+\frac{\pi}{2}} Sc \times r \cos\theta d\theta = Scr$

$$\left[\sin\theta\right]_{-\frac{\pi}{2}}^{+\frac{\pi}{2}} = 2\,Scr = Sc\,D \text{ where } D$$

is the diameter of the pin and $Sc = \frac{T}{D}$

Thus it will be seen that the unit stress derived by Mr. Wood differs from that which I have derived from

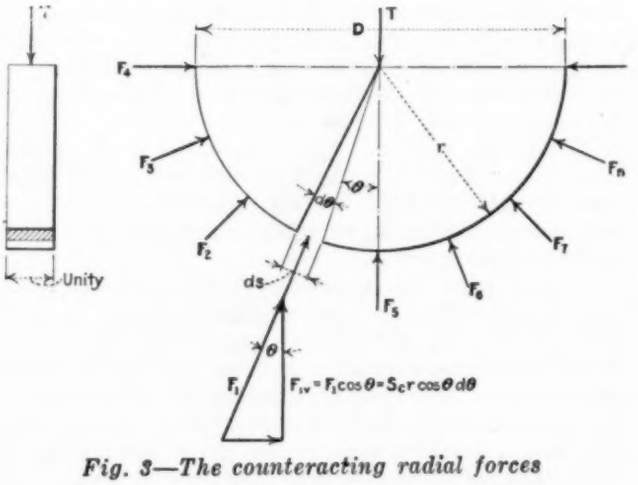


Fig. 3—The counteracting radial forces

the same data, and that his result must be multiplied by $\frac{\pi}{2}$ to obtain what I think to be the correct result. If there is an error in my derivation I would be glad to know exactly where it is. Further this is in accord with the well-known fact that where we have a uniform distribution of stress, the unit stress is the total vertical load divided by the projected area of the bearing.

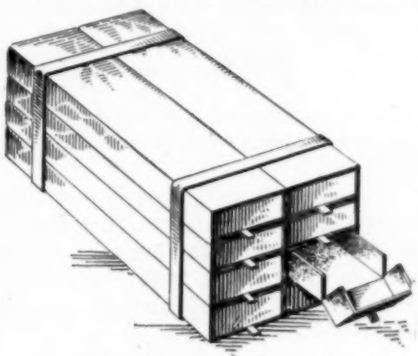
Ideas from Practical Men

The department, "Ideas from Practical Men," is devoted to the exchange of information on methods useful to the machinery industries. Its scope includes all divisions of the machine building industry, from drafting room to shipping platform. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for. The rates are from five dollars upward, according to their merit

A Handy Case

BY WARREN SCHOLL

Paper clips, extra pencils, brushes, etc., are always a nuisance around the drawing board or desk. If they are kept in a drawer, they roll around and get mixed up as the drawer is opened and closed, unless kept in separate boxes, or the drawer is partitioned off to suit them.



Inexpensive container for small articles

A very convenient case for such articles can be made by fastening several pencil boxes together by rubber bands, as shown in the illustration. By this method a separate drawer is provided for each article. The beauty of the scheme is that it costs practically nothing and drawers can be added when wanted, either at the top or at the side.

Angular Turning on a Milling Machine—Discussion

BY H. S. STEELE

The letter by Charles Kugler in reference to turning a piece of work in a milling machine, published on page 168, Vol. 64, of the *American Machinist*, calls to mind many occasions upon which I have used the milling machine in lieu of a lathe. Within reasonable limits, the milling machine is well adapted to lathe work, and ordinarily requires no alterations or additions of any kind.

I do not mean to imply that a milling machine should be regularly used to do lathe work while a lathe is standing idle, but in a busy toolroom there are many times when all the lathes are in use and when one of the workmen has a small job of lathe work that cannot be put aside. At such times the milling machine can be used to advantage on any job not too long or too large in diameter, that can be held on centers, on an arbor or in a chuck. The machine vise can be used as a toolpost without additions.

If the job is to be swung on centers, put the live center and driver belonging to the dividing head into the taper hole of the machine spindle (in most modern machines the shanks are interchangeable), and bring the outboard center into position to support the outer end of the work. A common lathe dog will do the driving.

If you are fussy about the parallelism of piece, grip the shank of an indicator in the vise, bring the ball of the indicator to bear against the work at a point near one end and adjust the pointer to read zero by manipulating the traverse screw, then run the saddle across until the indicator reaches the other end of the work and take the reading there. Be sure to turn the arbor or work, end for end each time, as you would do in a lathe, and have the ball of the indicator rest against the same place upon it, else the setting will be complicated by the taper of the arbor or by its possible eccentricity.

If the clamp holding the outboard support to the overarm is slightly tightened, the sidewise position of the outboard center may be adjusted by tapping the support lightly with a soft mallet. When the readings of the indicator at opposite ends of the work are alike, indicating that the line of centers is parallel with the line of travel of the saddle, the outboard-support clamp may be finally tightened. On most milling machines the outboard center has a screw adjustment endwise, by means of which the work may be released or reset as readily as in a lathe.

Any ordinary taper may be turned in the milling machine by swinging the outboard support on the overarm to one side far enough to give the outboard center the required amount of offset. This method will not, of course, produce a theoretically perfect taper, for the reason that the center begins to rise at the same time it starts to swing sidewise, but the proportionate amount of vertical departure from the true center line is so very slight, that upon any taper likely to be encountered in ordinary tool work there would be difficulty in measuring the error.

An angular facing job—a very difficult thing to do in any lathe that is not provided with a compound rest—is pie for the milling machine. Just set the centers as for parallel turning and then swivel the table to the required angle. The degree of angularity obtainable is limited only by the amount of swivel before the table strikes the column. On the job shown by Mr. Kugler, the angle is beyond the reach of this method and he was obliged to introduce a secondary slide-rest, for which he chose the slide of the milling machine vise.

For chuck boring or facing—the latter at any angle from 90 deg. up to the limit of swing of the table—the adaptation of the milling machine is equally simple; indeed, on some jobs this machine is to be preferred to the lathe because of the broad, horizontal surface

of the table upon which to set indicating and measuring devices, or as a dependable point of departure from which to take relative measurements.

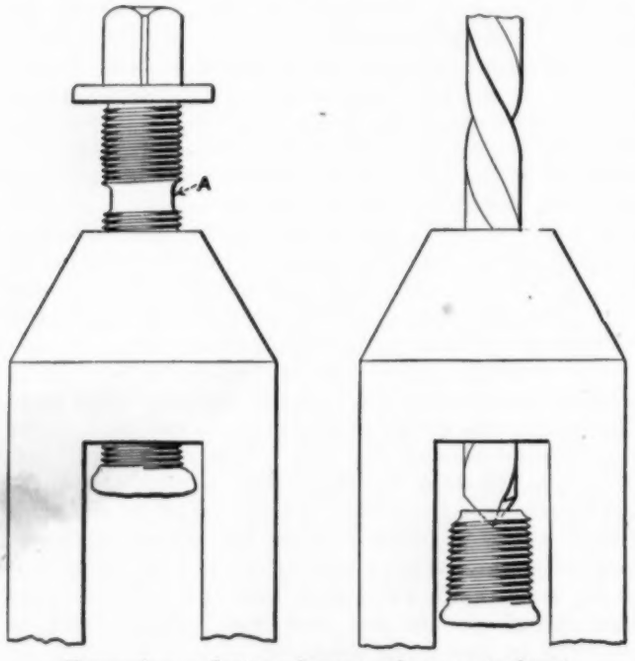
For work within its range, the vise of the milling machine is an ideal toolpost. The tool shank is gripped very firmly and the cutting point may be presented at any desired angle to the work by swiveling the vise, while unlimited vertical adjustment of the tool can be made by raising or lowering the knee.

Removing a Battered Toolpost Screw—Discussion

By Arthur R. Myers

In an article published on page 906, Vol. 63, of the *American Machinist*, H. L. Wheeler tells how to remove a battered toolpost screw. The method described by Mr. Wheeler is not as easily carried out as it appears. It has been my experience that no matter how soft the point of the screw may be, the threaded part is always hard. To cut the slots would ruin one and probably more hacksaw blades. Again, some screws are too short to allow cuts deep enough to break off the pieces.

A method I have used in removing battered toolpost screws, is to back the screw out of the toolpost as far as possible without having it bind in the tapped hole,



Removing a battered screw from a toolpost

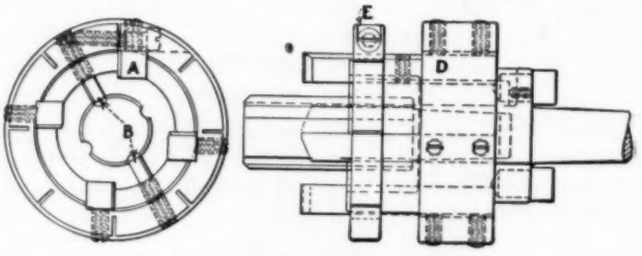
then grind a groove around the screw as close as possible to the toolpost as at *A*. Grinding cuts away the case and exposes the soft metal. The outer end can now be cut off by a hacksaw.

I then centerpunch the exposed part of the screw and put the toolpost in the drill press, holding it in a vise. With a drill smaller than a tap drill for that particular hole, and with the machine running slowly, I bring the drill down very quickly and jam it on the end of the screw. The drill bites into the screw and causes it to revolve and screws it out of the tapped hole and into the slot in the toolpost, from where it can readily be removed. The sketches show what I mean.

Tool for Hollow Milling and Facing

By A. W. Freeman

We had a large quantity of parts to make, in which the hubs were to be turned on the outside and the ends faced. At first the work was done in a lathe, and, while the results were satisfactory, we believed it could be done cheaper and quicker in a drilling machine provided with the proper tools. Accordingly, we made the hollow-milling and facing tool shown in the illustration. The body of the tool was made of machinery steel. Slots were milled to take four turning tools as at *A* and two



Tool for turning and facing hubs

tools for facing and rounding the corners as at *B*. A taper hole was also put in to receive the shank of the pilot.

The collar *D* was pressed on the body to carry the setscrews for locking the cutters, which were regular toolbits, $\frac{5}{8}$ in. square, and ground to fit the slots. The pilot was driven in and, with the cutters in place, the tool was placed between centers and the outsides of the cutters were ground to fit the split adjusting collar *E*.

In sizing the tool, the split collar was closed enough to close the turning cutters slightly under size, and they were then ground to size in an internal grinder. Since the cutting was all done by the ends of the cutters, it was not necessary to relieve them internally. The tool worked splendidly and fulfilled our expectations.

Using a Hand Reamer in a Lathe—Discussion

By H. S. Steele

May I be permitted to criticize your answer to the query under the title given above on page 72, Vol. 64, of the *American Machinist;* not that it is in error, for it is eminently correct, but that it does not sufficiently emphasize the inadvisability of using a hand reamer in the manner described.

A hand reamer is a very delicate tool; one that needs but little abuse to convert it from a relatively expensive piece of equipment to a worthless bit of junk. If for any reason its accuracy becomes impaired it is not only valueless of itself, but unless its error is at once detected it may spoil work of many times its cost.

The chances of overstraining and consequently ruining a hand reamer by applying to it any form of power other than manual energy, or using it in any manner that destroys the sensitivity of hand control, are so very great that there can be no justification for doing so. If enough stock is left in a bore to make the operation of hand reaming an unduly arduous one there is something wrong with the preliminary processes.

A hand reamer should *not* be used in a lathe.

S.A.E. Steels (Chemical Composition)

Definite applications of S. A. E. steels are not covered here, since it will be readily appreciated that the selection of a proper steel for a given part must depend upon an intimate knowledge of a number of important factors, such as the availability and price of the material, the detailed design of the part and the severity of the service to be imposed, whether the part is to be forged or machined, machineability and the method of manufacture. Only after a careful consideration of these factors can the proper steels for the greater variety of automotive parts be selected. Charts can be had that show the conservative physical properties of the S. A. E. steels, to give the designer data that will in most cases enable him to prepare a list of satisfactory steels from the standpoint of physical properties, after which the final choice will depend upon such local conditions as machineability, heat-treating, delivery and price.

The steel compositions given in this sheet are considered adequate for practically all parts made of ferrous materials that are necessary for the production of automotive apparatus, and include grades that have been found commercially available and technically adequate for the service required of such parts. In cases where very special reuirements or exceptional quality make it necessary, grades containing less phosphorous and sulphur and narrower ranges of carbon and manganese are available, but such steels should be obtained by special arrangement between the mill and the purchaser.

S. A. E. steels should be purchased on the basis of requirements as to chemical composition, and the specifications provided herein should be used in the purchase of the grades and types of steel covered by each. Requirements as to physical properties have been omitted, because the majority of steels for automotive purposes are either worked or given heat-treatments by the purchaser.

Carbon Steels

S. A. E. Steel No.	Carbon Range	Manganese Range	Phosphorus, Range	Sulphur, Max.
1,010	0.05–0.15	0.30–0.60	0.045	0.05
1,015	0.10–0.20	0.30–0.60	0.045	0.05
1,020	0.15–0.25	0.30–0.60	0.045	0.05
1,025	0.20–0.30	0.50–0.80	0.045	0.05
1,030	0.25–0.35	0.50–0.80	0.045	0.05
1,035	0.30–0.40	0.50–0.80	0.045	0.05
1,040	0.35–0.45	0.50–0.80	0.045	0.05
1,045	0.40–0.50	0.50–0.80	0.045	0.05
1,046	0.40–0.50	0.30–0.50	0.045	0.05
1,050	0.45–0.55	0.50–0.80	0.045	0.05
1,095	0.90–1.05	0.25–0.50	0.040	0.05
1,350[1]	0.45–0.55	0.90–1.20	0.040	0.05
1,360[1]	0.55–0.70	0.90–1.20	0.040	0.05

[1] The silicon content for steels Nos. 1,350 and 1,360 shall not exceed 0.30 per cent.

Screw Stock

S. A. E. Steel No.	Carbon Range	Manganese Range	Phosphorus Range	Sulphur Range
1,112	0.08–0.16	0.60–0.80	0.09–0.13	0.075–0.15
1,120	0.15–0.25	0.60–0.90	Max. 0.06	0.075–0.15

Nickel Steels

S. A. E. Steel No.	Carbon Range	Manganese Range	Phosphorus, Max.	Sulphur, Max.	Nickel Range
2,315	0.10–0.20	0.30–0.60	0.04	0.045	3.25–3.75
2,320	0.15–0.25	0.50–0.80	0.04	0.045	3.25–3.75
2,330	0.25–0.35	0.50–0.80	0.04	0.045	3.25–3.75
2,335	0.30–0.40	0.50–0.80	0.04	0.045	3.25–3.75
2,340	0.35–0.45	0.50–0.80	0.04	0.045	3.25–3.75
2,345	0.40–0.50	0.50–0.80	0.04	0.045	3.25–3.75
2,350	0.45–0.55	0.50–0.80	0.04	0.045	3.25–3.75
2,512	Max. 0.17	0.30–0.60	0.04	0.045	4.50–5.25

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Nickel-Chromium Steels

S. A. E. Steel No.	Carbon Range	Manganese Range	Phosphorus, Max.	Sulphur, Max.	Nickel Range	Chromium Range
3,115	0.10–0.20	0.30–0.60	0.04	0.045	1.00–1.50	0.45–0.75
3,120	0.15–0.25	0.30–0.60	0.04	0.045	1.00–1.50	0.45–0.75
3,125	0.20–0.30	0.50–0.80	0.04	0.045	1.00–1.50	0.45–0.75
3,130	0.25–0.35	0.50–0.80	0.04	0.045	1.00–1.50	0.45–0.75
3,135	0.30–0.40	0.50–0.80	0.04	0.045	1.00–1.50	0.45–0.75
3,140	0.35–0.45	0.50–0.80	0.04	0.045	1.00–1.50	0.45–0.75
3,215	0.10–0.20	0.30–0.60	0.04	0.040	1.50–2.00	0.90–1.25
3,220	0.15–0.25	0.30–0.60	0.04	0.040	1.50–2.00	0.90–1.25
3,230	0.25–0.35	0.30–0.60	0.04	0.040	1.50–2.00	0.90–1.25
3,240	0.35–0.45	0.30–0.60	0.04	0.040	1.50–2.00	0.90–1.25
3,245	0.40–0.50	0.30–0.60	0.04	0.040	1.50–2.00	0.90–1.25
3,250	0.45–0.55	0.30–0.60	0.04	0.040	1.50–2.00	0.90–1.25
3,312	Max. 0.17	0.30–0.60	0.04	0.040	3.25–3.75	1.25–1.75
3,325	0.20–0.30	0.30–0.60	0.04	0.040	3.25–3.75	1.25–1.75
3,335	0.30–0.40	0.30–0.60	0.04	0.040	3.25–3.75	1.25–1.75
3,340	0.35–0.45	0.30–0.60	0.04	0.040	3.25–3.75	1.25–1.75
3,415	0.10–0.20	0.45–0.75	0.04	0.040	2.75–3.25	0.60–0.95
3,435	0.30–0.40	0.45–0.75	0.04	0.040	2.75–3.25	0.60–0.95
3,450	0.45–0.55	0.45–0.75	0.04	0.040	2.75–3.25	0.60–0.95

Molybdenum Steels

S. A. E. Steel No.	Carbon Range	Manganese Range	Phosphorus, Max.	Sulphur, Max.	Chromium Range	Nickel Range	Molybdenum Range
4,130	0.25–0.35	0.40–0.70	0.04	0.045	0.50–0.80	.....	0.15–0.25
4,140	0.35–0.45	0.40–0.70	0.04	0.045	0.80–1.10	.....	0.15–0.25
4,150	0.45–0.55	0.40–0.70	0.04	0.045	0.80–1.10	.....	0.15–0.25
4,615	0.10–0.20	0.30–0.50	0.04	0.045	.....	1.25–1.75	0.20–0.30

Chromium Steels

S. A. E. Steel No.	Carbon Range	Manganese Range	Phosphorus, Max.	Sulphur, Max.	Chromium Range
5,120	0.15–0.25	0.30–0.60	0.04	0.045	0.60–0.90
5,140	0.35–0.45	0.50–0.80	0.04	0.045	0.80–1.10
5,150	0.45–0.55	0.50–0.80	0.04	0.045	0.80–1.10
52,100	0.95–1.10	0.20–0.50	0.03	0.030	1.20–1.50

Chromium-Vanadium Steels

S. A. E. Steel No.	Carbon Range	Manganese Range	Phosphorus, Max.	Sulphur, Max.	Chromium, Range	Vanadium Min.	Vanadium Desired
6,120	0.15–0.25	0.50–0.80	0.04	0.04	0.80–1.10	0.15	0.18
6,125	0.20–0.30	0.50–0.80	0.04	0.04	0.80–1.10	0.15	0.18
6,130	0.25–0.35	0.50–0.80	0.04	0.04	0.80–1.10	0.15	0.18
6,135	0.30–0.40	0.50–0.80	0.04	0.04	0.80–1.10	0.15	0.18
6,140	0.35–0.45	0.50–0.80	0.04	0.04	0.80–1.10	0.15	0.18
6,145	0.40–0.50	0.50–0.80	0.04	0.04	0.80–1.10	0.15	0.18
6,150	0.45–0.55	0.50–0.80	0.04	0.04	0.80–1.10	0.15	0.18
6,195	0.90–1.05	0.20–0.45	0.03	0.03	0.80–1.10	0.15	0.18

Tungsten Steels

S. A. E. Steel No.	Carbon Range	Manganese, Max.	Phosphorus, Max.	Sulphur, Max.	Chromium, Range	Tungsten Range
71,360	0.50–0.70	0.30	0.035	0.035	3.00–4.00	12.00–15.00
71,660	0.50–0.70	0.30	0.035	0.035	3.00–4.00	15.00–18.00
7,260	0.50–0.70	0.30	0.035	0.035	0.50–1.00	1.50– 2.00

Silico-Manganese Steels

S. A. E. Steel No.	Carbon Range	Manganese Range	Phosphorus, Max.	Sulphur, Max.	Silicon Range
9,250	0.45–0.55	0.60–0.90	0.045	0.045	1.80–2.20
9,260	0.55–0.65	0.60–0.90	0.045	0.045	1.80–2.20

Practical Shop Problems

Questions of a Practical Nature will be answered in these columns

Dangerous Alterations on Pneumatic Hammers

Q. We have found that we can use a shorter piston than is regularly furnished in our air hammers and get a more rapid blow on the work. Unless there is some danger in this practice, however, we believe that shorter pistons would be furnished by the makers, so please tell us why the shorter piston is not correct.

A. Using a shorter piston will, as you say, cause the hammer to deliver a more rapid blow and actually do more work. This increased speed, however, is beyond that which the manufacturers have found safe for the material in the piston. The end of the piston strikes so sharp a blow that the piston will chip off and the broken parts will cut the hammer cylinder and will eveutually crack the barrel, if the cylinder is not ruined before this occurs.

Studying the Use of High Speed Cutting Tools

Q. We are anxious to compile some information for the use of our machine shop, showing the latest practice and standards with respect to the kind of high-speed steel cutting tools to use, the methods for grinding them, the heat treatment procedure, the proper feeds, speeds and depth of cut, and their use in general on cast-iron, steel, bronze, and other metals. Please tell us where we can secure up-to-date and authoritative information on this subject.

A. For data as to speeds, feeds depth of cut and similar items in connection with the various metals, we suggest that you consult the *American Machinist* Handbook, published by the McGraw-Hill Book Co., and the other standard works which deal with this important phase of manufacturing.

In order to find out the best practice with regard to grinding, heat treating and other items pertaining to the steels themselves, we believe it would be to your best advantage to consult the manufacturers of the steel that you are using or propose to use.

No definite rules can be laid down for the various points in connection with these steels, as each manufacturer has found through practice and experiment that certain points fit a certain particular steel. The principal manufacturers, however, have prepared data on the subject that are surprisingly complete and can be had for the asking.

Doubtless, you have a list of the various high-speed and cutting-tool steel manufacturers among whom you have made certain choices for your own uses, but if you do not happen to have this list and will let us know, we shall be glad to furnish it for you. We are also suggesting that in your study you consider the use of stellite, which you will not find listed under the steels, since it has no iron content.

In short, reference can be made to the standard handbooks for data on uses, but information concerning the conditioning of the steels for the work in hand can best be made by getting into direct contact with the cutting tool manufacturers.

Pipe Welding with Thermit

Q. Please outline the process of making a pipe weld with thermit. We understand that the thermit itself does not constitute a part of the finished work.

A. The pipe ends are cleaned, squared and butted together. They are surrounded with a two-part cast-iron mold with an opening at the top. The mold is 4 or 5 in. long and fits the pipe at its ends, but is hollowed out inside to constitute a ring for the thermit to surround the pipe. A clamp that can be used to force the pipe ends against each other is then secured beyond each end of the mold and the preparation for welding is complete.

The thermit is poured, after the reaction has taken place, from a ladle rather than from a crucible so that the ordinary arrangement is reversed and the slag which floats on top the molten metal enters the mold first, ahead of the metal instead of being kept out entirely by "bottom" pouring from the crucible. Just enough thermit is used to fill the mold with the resulting slag and hot metal.

The slag coats the pipe and the mold so the metal will not stick to either and solidifies at once upon touching the pipe so none enters between the ends. The molten metal furnishes sufficient heat to bring the pipe ends to welding heat. When this point is reached, the clamp is drawn in, the pipe ends are forced together and a butt weld results. As soon as the thermit has cooled sufficiently, the clamp is removed, the mold is opened, and the thermit and slag are knocked off from around the completed weld.

The thermit is used to supply the heat and does not constitute any part of the weld.

Cutting Thick Steel Sections with the Gas Torch

Q. In cutting steel with the gas torch, is there any particular advantage in using hydrogen in the place of the usual acetylene gas?

A. The flame from a combination of oxygen and hydrogen is longer than that which can be obtained with oxygen and acetylene so that it has greater penetration and is of particular advantage in cutting through thick sections.

While the practical limit for acetylene is about 7 inches, hydrogen and oxygen can be made to cut through three times that much.

Technical Abstracts

Analyzing Employee Attitude

The constructive type of workmen as a capacity worker, characterized by an active interest in his job, is described by John F. Sherman, president of the Sherman Service, Inc. He is ambitious and forward-looking, satisfied with his opportunities, and willing to work hard to avail himself of them to the maximum. He is often not at all demonstrative and when pressed for an opinion as to how he feels about this or that, may not even choose to voice his actual constructive attitude. His production does reflect his attitude, however, and is consistently up to the normal of what a man can accomplish without strain. Of course, he has his off days as everyone does, but the satisfactory quality and normal quantity of his work are disturbed comparatively little, and he pursues a course which, day in and day out, assures the business one hundred cents in value on every dollar of wage. And this worker himself gains in self-respect and in material advantages, for it is an everlasting verity of life, even though the expression of it sounds bromidic, that "we get out what we we put in." There is a direct ratio between a man's personal satisfaction and well-being and the amount of himself that he puts into his effort.

There are indications in our industrial and social life that we are trying to get away from this truth. Observers tell us that the idea which underlies the struggle for less work and more pay is not confined to this country, but is met with in all countries today in greater degree than in the past.

The worker of the negative type is the direct opposite. His daily and hourly performance shows an active dislike for the job, and for the conditions surrounding it. Unfortunately he is often highly vocal, in direct contrast to the constructive employee. A common treatment of this negative type is to fire him. Scrapping a human being without persistent effort toward rehabilitation is no more intelligent than it would be to throw on the dump heap a machine in which defects have developed, since such an employee is usually far from hopeless. Discharge does not get to the fundamental cause of the losses and wastes which arise from his actions—their root is in his attitude or motive, and that attitude can be rehabilitated. — *Industrial Management*, Jan., 1926, p. 19.

Trends in the Machine Tool Industry

In spite of a wonderful background, the machine tool industry is woefully misunderstood, miserably underpaid and is one of the least known of the fundamental industries, according to John Henry. It is subjected to such rapid inflations and sharp declines that it is impossible to make a "spread" that will cover the losses and insure an adequate return upon the investment required and the technique involved in producing machine tools.

A large part of the blame for these conditions must be laid upon the industry itself. In the first place, its development has been controlled by the engineering side of the organization, subject, of course, to financial supervision. The selling and marketing side has been sadly neglected. Tradition has played too large a part in the scheme of things. Conservatism and secretiveness have been responsible for slow progress. There is still a tendency to follow rather than lead, although the new generation is making radical changes. Marketing of machine tools is becoming more efficient. New models are not being built to suit the whim of a designer or the fancied need of an isolated case—they are being built for an industry. The machine tool builder of today is becoming a specialist and his plant is on a production basis instead of being an experimental station.

At some time in the not far distant future the machine tool industry will have resident engineers—men of marketing experience—located in the great industrial centers studying the needs of industries and reporting back to a central bureau or an individual organization. Upon the recommendations of these men the machine tools of the future will be designed.—*Advertising and Selling Fortnightly*, Jan. 13, p. 25.

Tracing Materials

J. E. Nelson, metallurgist of the Barber-Colman Co., describes the methods used to check up the quality of incoming material, particularly steel, and for keeping a record of it through to the finished product. A record is also kept after the part has left the plant in case some difficulty is encountered in its use.

As a shipment of steel is received each bar is given a number. A disk one quarter of an inch thick is cut from bars 1 in. and over in diameter. The disk is given the same number as the bar and is sent to the laboratory with a report card giving the number, size and grade of the material. A chemical analysis is made on a certain percentage of the total number of bars, but each bar is given a metallurgical test. The disks are first examined for dirt, segregation, cracks and porosity. They are then tested for hardness with the Brinell machine, and drilled and hardened. Carbon tool steel and oil-hardening steels are examined in a soft condition for microstructure.

Report cards of the examination are filled out and returned to the stock room where they are filed. The laboratory also keeps a record of the bar. The card accompanies the work through the plant and when it reaches the heat-treating department a record is made showing the kind of tool, size, name of customer, heat-treatment and bar number. Records of three colors are used, red for high speed, yellow for carbon tool steel and white for carburizing work. After the heat-treatment of the steel, this particular card record is filed and should any difficulty be encountered during the process of manufacture, a reference can always be made to the history of the original bar.—*Transactions of the American Society for Steel Treating*, Jan., 1926, p. 133.

American Machinist

KENNETH H. CONDIT AND FRED H. COLVIN
Editors

Established 1877

Selling Old Machines for Scrap

"BUYING machine tools for production and selling them by the pound" is not so far from modern ideas as might be imagined. Many production shops work their machines so as to get the full productive value out of them in a very few years. If the machines are at all special, the cupola is the only place for them.

In contrast to this practice of getting your money out of a machine in the shortest possible time, we note a list of machines offered for sale by a well known ship building corporation. Many of the machines listed would make a fine exhibit in a museum or a millionaire's collection of antiques. The list contains machines built long before the average shop man of today can remember. Good machines in their day, they were out of date 30 years ago and have been a liability instead of an asset, ever since. The dividends that have been lost by continuing to use machines as old as these, cannot, of course, be calculated.

The hopeful feature of the situation is that the management now recognizes the futility of trying to run a modern shop with old machines and "will consider bids on a pound basis." No one could afford to accept most of them as a gift, except for the cupola.

The Railroads and Union-Management Co-operation

UNION-MANAGEMENT co-operation in the railway industry is apparently successful. Four railways are using it as applied to shop work. A few nights ago the engineer who designed the plan, a representative of the railway employees, and the president of one of the four railways spoke from the same platform and all endorsed the results secured during the past two years.

In conducting the railway activities according to the plan the unions and management co-operate to eliminate waste and to promote efficiency. Seven basic requirements upon which the life of the plan depends were given by the engineer. They are:

Full and cordial recognition of the standard unions as the properly accredited agents to represent railroad employees with management.

Acceptance by management of the standard unions as helpful, necessary and constructive in the conduct of the railway industry.

Development between unions and management of written agreements governing wages, working conditions and the prompt and orderly adjustment of disputes.

Systematic co-operation between unions and management for improved railroad service and elimination of waste.

Stabilization of employment.

Measuring, visualizing and sharing fairly the gains of co-operation.

Perfection of definite joint union-management administrative machinery to promote co-operative effort.

The railway president was not hitting very wide of the mark when he said: "Union-management co-operation in the railway industry seeks to achieve as a primary objective continuity of employment, and in the accomplishment of this objective is destined to play a great and useful part. It already has been applied to shop work and if successful I can see no reason why it should not be equally applied to other industries.

"The most fearsome thing in the life of the laboring man is the lack of knowledge that his job is secure from day to day and that his family will be as surely cared for a year from now as now. This is the heart of the plan. It will insure to capable, willing workmen continuity of employment."

Perhaps this step taken by the railways is a forerunner of a new kind of industrial balance. It will bear the most careful observation and study by other railroads and by other industries.

The French Exchange Professorship

EVERY one has heard of the Rhodes Scholarships and knows how valuable they have been in promoting close friendship between the United States and Great Britain. Almost equally well known are Boxer Indemnity scholarships. Not so much is heard, however, of the exchange professorships that have been so successful in bringing together the best thinkers of one country and the students of another.

For several years certain American universities have united to finance exchange professorships with a group of French universities. The straitened circumstances of the French institutions of learning have made it increasingly difficult for them to find the money required for the expenses of their representative to the American schools. Last year, in fact, it was only possible for the professor sent over to stay a few weeks, a regrettable situation because he should have stayed that long at each of the American colleges.

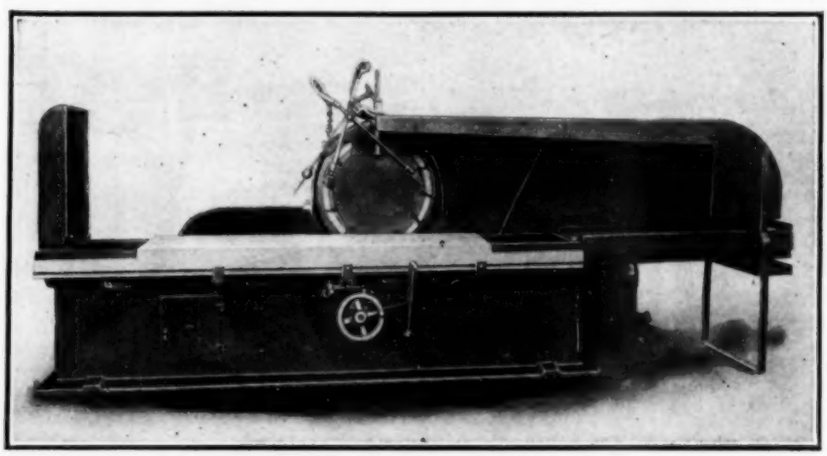
A sum of five thousand dollars annually is needed to defray the cost of sending a French exchange professor to America for the academic year. Those who feel that the plan is good and should be continued, and who are willing to contribute to the fund, should communicate with Calvin W. Rice, secretary of the American Society of Mechanical Engineers, which society has interested itself in the project.

Shop Equipment News

Diamond Face-Grinding Machine Improved

The Diamond Machine Co., 9 Codding St., Providence, R. I., has redesigned its line of face-grinding machines, one model of which was described on page 155, Vol. 60 of the *American Machinist*. The improved machines are built in sizes to accommodate grinding wheels 30, 36, 54 and 66 in diam. and with tables in various lengths up to 18 feet.

The 30- and 36-in. machines are driven from 40-hp. motors of the 40-deg. type at speeds of either 900 or 1,200 r.p.m. The drive is through a Morse silent chain and sprockets. The chain is of ¾-pitch and is 7 in. wide. A guard is provided to inclose the chain. The crossbelts for operating the table are 2 in. wide.



Diamond Face-Grinding Machine, Improved

A special sectional wheel chuck is furnished to accommodate twelve abrasive blocks for the 30-in. machine and fifteen blocks for the 36-in. machine. These blocks are 7½ in. deep and either 2 or 3 in. wide, as desired. The segments are adjustable for wheel wear for over 6 in. of their depth before renewal. This type of wheel replaces the one described in connection with the earlier models. The diameter of the spindle is 5 in. in the front and 4½ in. in the rear for the 30-in. machine, and 6 in. in the front and 5½ in. in the rear bearings of the 36-in. machine.

The table has been redesigned to provide quicker drainage and to make cleaning easier. The flat table ways have been made wider and the V-ways are deeper. The total width of the table is 24 in. and the length of the table is 134 in. for the two sizes of machines above mentioned. The platen of the table is central in its length and is 24x86 in. It is provided with five T-slots for ¾-in. bolts. The first slot is 2¼ in. from the edge of the platen nearest the abrasive wheel. The slots have 4⅞ in. center distance. The table gears are cut from solid steel. The bull gear has a 2½-in. face.

The main water tank has a capacity of 49 gal. and the settling tank will hold 10 gal. A steep-sloping quick-draining water trough is provided. The machine is equipped with two nozzles each having a discharge opening of from ¼ to 1¼ in. The pump operates at a speed of 900 r.p.m. and is of the submerged centrifugal type.

The bearings are of the split type of bronze with three oil rings in the front and two oil rings in the rear. Larger oil pockets and oil rolls afford better lubrication to the table ways.

The capacity of the machines allows for a maximum height of grinding room of 20 in. for the 30-in. machine and 27 in. for the 36-in. machine. With the front guard plate removed the maximum height is 24 and 30 in., respectively. The maximum length that may be ground on either machine is 84 inches.

The bed of the machine is now being made with square ends to add to the strength and to the appearance of the grinder. It is of the three-point type, bearing on the floor with a total length of 134 in. It has a 90-deg. V-way in front, 3½ in. wide, and a flat way at the rear, 4 in. wide. Two flat ways 6 in. wide with a total spread of 30 in. carry the wheelhead. The operating position has been moved closer to the table, thus enabling the operator a better view of the work and easier control of the machine.

The grinder is provided with a hand cross-feed operated from the rear. The total amount of this cross-feed is 2⅝ in. The automatic cross-feed has a range of from 0.001 to 0.010 in. One revolution of the rear handwheel moves the wheelhead ⅛ in. The table traverse is controlled by hand or by power from either the front or the rear of the machine.

The total floor space occupied by either machine is 8 ft. and 4 in. front to back, and 25 ft. and 2 in. from end to end. The net weight, without the motor, is 14,000 lb. for the 30-in. machine and 15,500 lb. for the 36-in. machine. The motor weighs 2,000 pounds.

"John" Reversing Tapping Chuck

A friction-drive reversing tapping chuck has been placed on the market by the Barber-Colman Co., Rockford, Ill. The "John" tapping chuck is designed to convert drills or speed lathes into tapping machines. It drives the tap direct from the spindle through its internal clutch and friction drive member. The friction drive can be adjusted to drive small taps without forcing them to the breaking point, or it can be set to

Shop Equipment News

act as a nearly positive drive for the heavier taps.

The tap is fed into the work and automatically reversed by the lowering and the raising of the drill press spindle. The reversing speed is twice that of the forward speed. The entire driving mechanism is

"John" Reversing Tapping Chuck

balanced and concentric with its spindle. The unit is inclosed in an oil-tight case, permitting all gears and moving parts to run in heavy oil or light grease. A hold rod is bolted to the case to prevent the body of the chuck and the plate carrying the reversing idler pinion from rotating. The rod can be used whether the chuck is fitted to a drill press or to a speed lathe.

The jaws of the chuck are loosely keyed together with a keeper plate, but they are free to slide in the drive shank. The inner ends of the jaws are beveled, and as the closing nut forces the jaws to grip the tap, the jaws accommodate themselves to the square of the tap shank.

The metal parts in the tap-holding and friction-drive unit are made from steel and are heat-treated, as are the center gear, pinions and clutch members. The internal gear is of bronze. The bearings are bushed and are renewable. The inclosing case is made from cast iron.

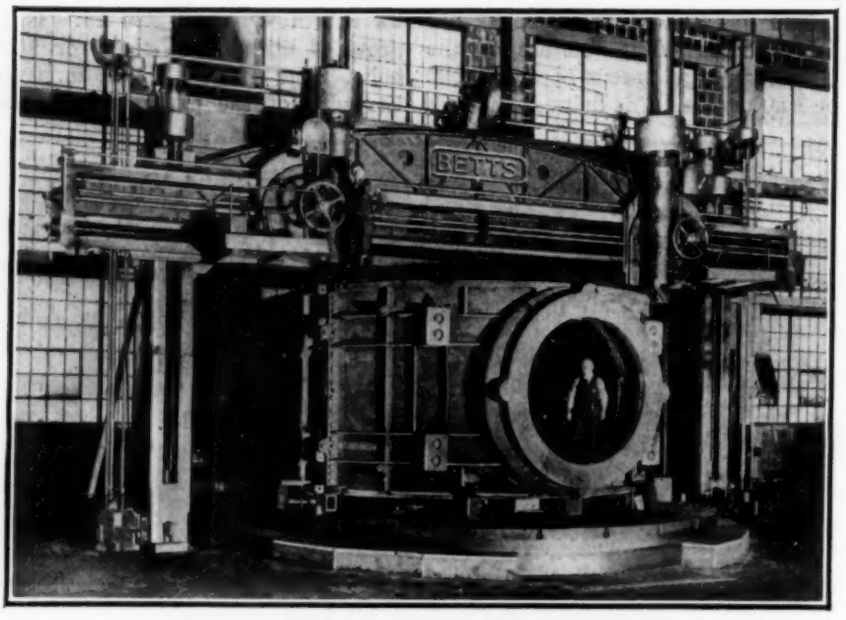
The chucks are made in two sizes: size No. 1 for taps from 0 to ⅜ in., and size No. 2 for taps from 0 to ⅝ in. They are equipped with Morse Nos. 2 and 3 taper shanks, respectively.

"Betts" Vertical Boring Mill, 32-Foot

A large vertical boring mill has been added to the line of similar tools built by the Betts Works of the Consolidated Machine Tool Corporation of America, Rochester, N. Y. The boring mill is shown machining a 197,900-lb. turbine casting. The bed, table and upright are of massive construction to resist the strains of heavy cuts on large work. The cross-rail is of a deep construction, extending back between the uprights to provide adequate stiffness. It is substantially reinforced at the top with a wide, heavily ribbed cross brace. It has a narrow guide for the saddles, and the clamping to the uprights is accomplished by means of air-operated gibs on the inside and the outside of each upright flange.

Independent operator's platforms are provided on each saddle. From these points all motors can be controlled by means of push-button stations. Duplicate stationary levers are also located on each side of the machine. These are for selecting vertical and horizontal feed, vertical and horizontal rapid power traverse and for reversing the feed and traverse. Rapid hand traverse is also controlled from these platforms.

The mill is driven by means of a 75-hp., variable-speed motor. Three mechanical speed changes are provided through inclosed steel gears. A 3-to-1 ratio from the motor has been adopted. The large table gear is also of steel.



"Betts" Vertical Boring Mill, 32-Foot

The tool spindles are steel forgings. They have screw feed and are balanced by means of ring-type counterweights. They are equipped with both hand and power movements. They can be swiveled, if desired, for angular work.

A 25-hp. motor is used for raising and lowering the cross-rail and for driving the rapid power traverse to the saddles and the tool spindles. This motor is mounted on top of the machine. The feeds are obtained through sliding steel gears with independent feed boxes on each side of the machine.

The machine has a table 24 ft. in diam. with a swing of 32 ft. and 3 in. The height under the tool holders is 12½ ft. The tool spindles have a travel of 10 ft. Forced lubrication to the annular bearings on the bed is provided by means of a special motor-driven pump. Ample lubrication is provided for all other bearings on the machine.

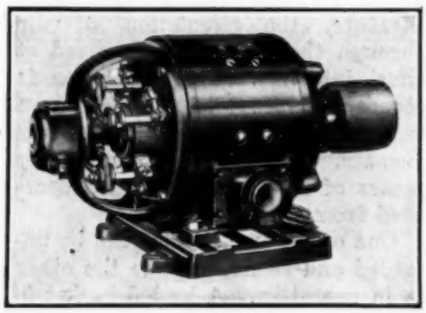
This boring mill is one of a line of similar tools manufactured by the company. A smaller machine with a table 8 ft. in diameter and with a swing of 100 in. has been previously described on page 220, Vol. 64 of the *American Machinist*.

Shop Equipment News

Louis Allis Direct-Current Motors, Type N. A.

A line of d.c. motors is being introduced by the Louis Allis Co., 133 Stewart St., Milwaukee, Wis., to be known as its type N.A. This series is interchangeable, rating for rating, in its essential dimensions with the line of polyphase motors manufactured by this company and previously described on page 205, Vol. 58, of the *American Machinist.*

The motor has a 40-deg. rating with heavy overload capacity and is



Louis Allis Direct-Current Motor, Type N. A.

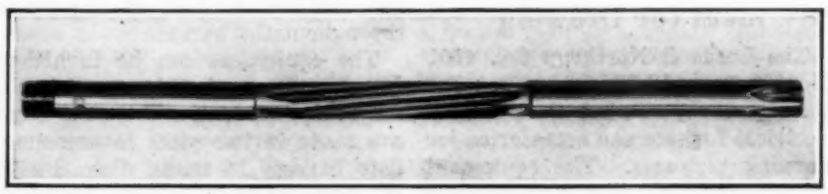
for general-purpose work. Ventilation is provided throughout the windings to insure coolness. Ring-oiled sleeve bearings are used. The bearing chamber is designed to hold a large quantity of oil to make frequent renewals unnecessary. The bearing inspection opening is closed by means of a dust-tight removable cover.

Watervliet Spiral King-Bolt Hole Reamer

The Watervliet Tool Co., Albany, N. Y., is manufacturing the spiral reamer illustrated for use in securing alignment of holes. The reamer has a pilot which enters the lower bushing before the tool begins to ream the upper bushing.

The pilot of the reamer is self-cutting. By this means the rough cutting is first accomplished while the reamer itself does only the finish cutting as it follows the aligning pilot.

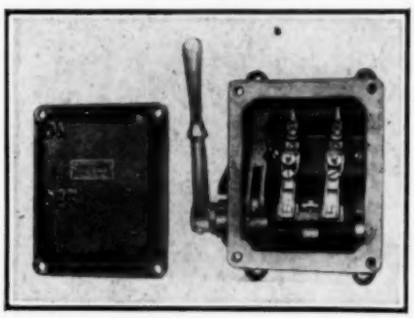
The reamers are made from tool steel, heat-treated in electrically controlled gas furnaces. They have a left-hand spiral. The line includes also spiral expansion aligning reamers.



Watervliet Spiral King-Bolt Hole Reamer

Cutler-Hammer Water-Tight Remote Control Station

The remote control station illustrated has been brought out by the Cutler-Hammer Manufacturing Co., Milwaukee, Wis., for use where it is necessary to protect electrical apparatus against moisture and acid fumes. The mechanism is inclosed in a cast-iron case which has a cover fitted with a gasket. A stuffing



Cutler-Hammer Water-Tight Remote Control Station

gland fitted to the shaft provides a tight joint and the thick wall of the cast-iron body allows enough threads for a tight conduit or pipe connection. The model illustrated is of the two-wire type.

Contact is made on the brass cylinder by means of two heavy fingers of standard non-stubbing design. These fingers are of sufficient capacity to permit the use of the control station on any pilot circuit at all industrial voltages.

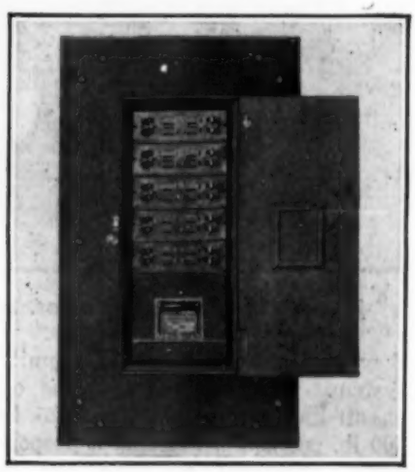
The handle is made from polished brass. It extends far enough from the case to indicate whether the circuit is open or closed. All parts are of a heavy, sturdy design.

Westinghouse Industrial Switch Panelboard

A line of industrial panelboards for the control of lighting systems in offices and factories has been placed on the market by the Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa. These panelboards are made in sizes supplying from 4 to 32 circuits and in capacities ranging from 30 to 100 amperes.

They are constructed with two doors, one within the other. The smaller door, giving access to the switch compartment, has a snap catch and may be opened by anyone. The larger door, opening into the fuses, is equipped with a Yale lock so that only authorized persons can open it.

The panelboards are built up in unit construction with eight single-pull or double-pull switches. When



Westinghouse Industrial Switch Panelboard

single-pull switches are used, the unit consists of two single-pull switches built on a composition base. With double-pull switches, the unit consists of one double-pull switch on a base of the same material. These units may be easily removed from the front of the panel board, making inspection and replacement easy.

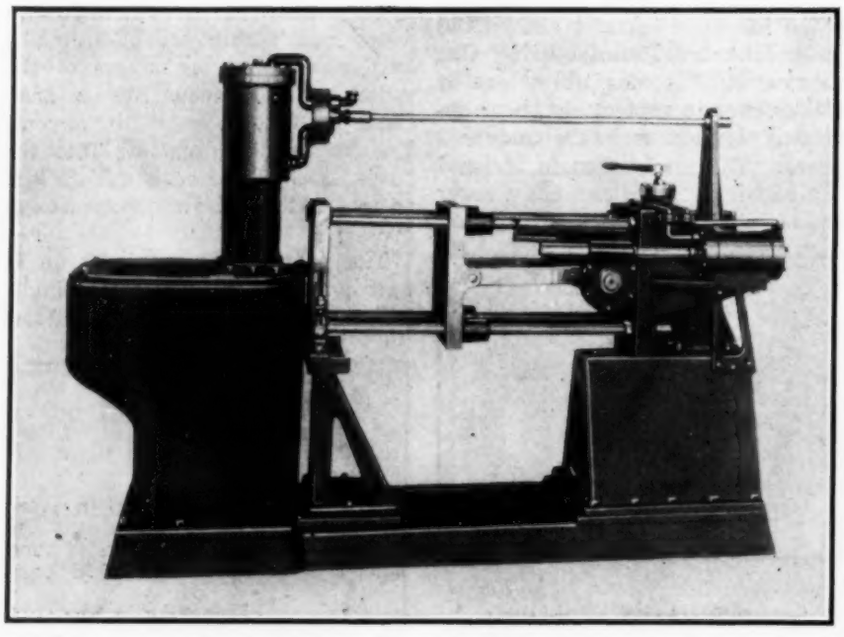
The cabinet fronts of these panelboards are equipped with the Westinghouse standard trim clamp for mounting the trim on the box. This clamp permits easy adjustment of the panelboard trim when the box has been set out of plumb. The trim clamp allows a ¾-in. adjustment.

Shop Equipment News

Simplex Die-Casting Machine, Improved

An improved semi-automatic machine for die-casting has been brought out by the Simplex Casting Machine Co., 21152 12th St., Brightmoor, Detroit, Mich. The machine, which is illustrated, is air driven and uses oil, gas or electricity as a means for heating the melting pot

The dies are water-cooled to increase their production and life, and they are lubricated by the Alemite system. The machine operates on an air-line pressure of from 25 to 100 lb. per sq.in., exerting a proportionate pressure of from 500 to 2,000 lb. per sq.in. upon the molten metal.



Simplex Die-Casting Machine, Improved

The machine is designed for one-man operation and is controlled by means of two levers, one of which governs the carriage mechanism, while the other governs the flow of molten metal into the dies. Power for moving the die carriage is derived from two air cylinders, one on each side of the machine. These cylinders operate racks which revolve pinions on two ends of a crankshaft. The crankshaft is direct-connected to the die carriage for sliding it back and forth. The piston coupling is constructed so that pistons can be changed and so that the metal piston bushing can be adjusted for compensation of wear or removed while the pot is full of metal and is hot. A specially constructed disk valve forms an air cushion on the return stroke of the machine. An automatic ejector removes the castings from the dies. A positive double-link locking mechanism prevents the dies from opening when pressure is on the metal.

The metal pot can be completely drained when it is necessary to change or replace it. The water-cooled nozzle is of alloy and will not anneal under 2,000 deg. F. It is claimed that the nozzle will not warp, score or crack under repeated heating and cooling.

The capacity of the pot is 500 lb. of white brass. The air required is 100 cu.ft. per hr. on castings up to 7½ lb. in weight. The floor space required is 86x26 in. and the height of the machine is 70 in. It weighs approximately 5,000 pounds.

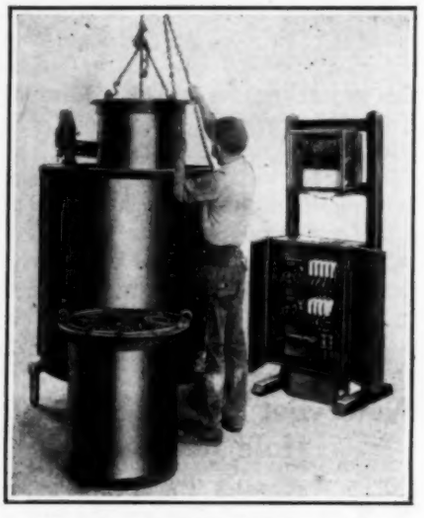
"Homo" Furnace Equipment for Drawing

The Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa., has placed on the market the "Homo" electrical furnace and accessories for drawing purposes. The equipment includes the furnace, two baskets for holding the work, a single-point recording potentiometer controller and an automatic control panel.

The control is maintained automatically by the recorder which can be seen in the illustration. A front setting device enables the operator to set the temperature at any desired point after which the controller automatically varies the current input from the high load needed to bring up the temperature, to the light load needed to hold it for the period desired.

The furnace is of the forced convection type and uses air as its medium. To secure uniformity of temperature, the circulation of air through the furnace is reversed at short intervals. The circulation is secured by means of a fan set on a vertical axis at the bottom of the furnace. The fan is reversed by means of an automatic switch operated from the controller.

One of the two baskets can be unloaded and reloaded while the other is in operation. A loaded basket is set in the furnace and the lid closed. The basket is shielded from the electrical heating coils so that the heat transmitted will be by convection, through the circulation of the air, and not by radiation. It is designed for uniform heating of the parts throughout the basket.



"Homo" Furnace Equipment for Drawing

The equipment can be furnished for operation on 110- or 220-volt, a.c. or d.c. current, and the furnaces are made in two sizes to accommodate baskets 14 in. in diam. by 16 in. deep and 20 in. in diam. by 26 in. deep.

News of the Week

Principles of Simplified Practice Are Gaining Favor in All Countries

More than five hundred industrial groups now interested

Consideration by American industry and commerce of simplified practice as a means of meeting problems of investment, equipment, materials and time, has spread during the past year at a rate which has far surpassed that of any period since the Department of Commerce first turned its attention to co-operation with industry in the campaign for the elimination of waste in industry.

This interest in, and recognition of, the value of the movement to eliminate waste by weeding out excessive variety, is not merely confined to the United States, but is attracting wide attention in other nations. This is also forseen by industrial engineers, technicians, and scientists, management engineers and educators in this country.

Wide interest is also being shown by the financial community, both by bankers' associations and by great banking institutions. Their interest in the subject is based on its effect of increasing productivity with lower costs and smaller capital investments; and their comment has been that the movement is an influence for easier money rates in financing industrial projects.

Visitors from several foreign countries have made careful inquiry as to the division's work, its methods, and its effect; while engineering bodies, educational leaders, trade associations and others in foreign lands have asked for information and publications of the division.

More than 500 industrial groups are in contact with the division, and these have been divided according to their census classifications for convenience in determining the extent to which simplification has penetrated or is being applied, in the major branches of American industry.

In the iron and steel field, 16 simplified practice recommendations are in effect; 16 are in progress, and 29 others proposed.

Second only to the iron and steel field in its attention to simplified practice, it is pointed out, was the machinery field, in which 45 items were under consideration. These included five simplified practice programs well under way, and 28 others suggested for the division's co-operation.

Pensions for Industrial Workers a Problem for Executives Today

Conference Board reports on progress being made

Caring for the workers who have grown old in its service is a problem for industry to work out for itself, in the view of leading industrial executives as reflected in an exhaustive research report on "Industrial Pensions In the United States," just completed by the National Industrial Conference Board.

The voluntary assumption by private industry itself of "such responsibility for the welfare of its personnel and the improvement of industrial relations as it is capable of discharging efficiently," is favored as in harmony with American ideals of individual initiative and independence.

The available evidence, according to the board's report, points to the conclusion that the aims and purposes of pension plans are realized in practice, not in all cases, or in every particular in every individual case, but on the whole. It is sharply emphasized, however, that the industrial pension problem is one of the most intricate confronting industry, and that pension plans to a large extent are "still in the experimental stage." While industrial pensioning is perfectly feasible if properly organized and administered, according to the report, the cumulative character and rapidly mounting costs of pensions too often are not properly appraised, and the necessity of funding any pension plan on a scientific basis if future embarrassment is to be avoided is stressed with recurrent emphasis.

While actuarial advice in establishing a pension plan is deemed expedient by some executives, the task of correctly estimating and properly funding the cost of a pension plan is by no means beyond the ability or resource of industrial management, the report declares. In its study of the problem, however, the board has encountered considerable objection to making the functioning of a pension plan an automatic procedure by turning over the entire administration of such plan to an outside agency.

The report offers advice for the organization, financing and administering of pension plans, embodying the principles and practical considerations of the pension problem as illustrated by the study of the experience with 248 different "formal" plans conducted by 245 different firms, and 148 additional "informal" pension plans operated on an individual merit and discretionary basis. The investigation of the Conference Board has aimed to include every pension plan operative in private industrial, mercantile and financial establishments, including those conducted by railroads, public utilities and several semi-public institutions, and the coverage is believed by the Board to be virtually complete within these limits.

Altitude-Pressure Tables Are Now Available

The Army Air Service, the Bureau of Aeronautics of the Navy, the National Advisory Committee for Aeronautics, the Weather Bureau, the Bureau of Standards, and the National Aeronautic Association have recently adopted a new standard altitude-pressure-temperature relation for use as an altimeter calibration standard which approximates average atmospheric conditions up to an altitude of at least 50,000 ft. This is of importance in calibrating the instruments used by aircraft to determine the height at which they are flying. Such instruments are known as altimeters. They operate on the principle of an aneroid barometer, that is, the variation in the pressure of the atmosphere on a flexible diaphragm causes motion of a pointer.

The old altimeter calibration standard contained the assumption that the atmosphere is at an average temperature of 50 deg. F. for all altitudes. This represents average conditions up to heights of 12,000 ft. quite accurately but above an altitude of 12,000 ft. it is not even approximately correct. Above these altitudes the temperature of the air is very much colder. For this reason readings of altimeters calibrated to this old standard are entirely inaccurate at the high altitudes at which planes now often fly. In order to take care of this problem a conference of the government organizations interested was held about a year ago, and it was decided to adopt a relation for use in calibrating instruments which was more nearly in accord with the average condition of the atmosphere. A set of altitude tables based on this new standard are essential in order to calibrate instruments.

These tables were prepared by the Bureau of Standards as the result of work in its laboratories, and have now been issued in mimeograph form. They are known as Letter Circular, No. 187, "Altitude-Pressure Tables Based on the United States Standard Atmosphere." Copies may be obtained by those having actual use for this material by addressing the Aeronautic Instruments Section of the Bureau of Standards.

Mass Production Possible Through Use of Limit Gage Standards

Mass production—that form of production which makes possible the largest output of the highest quality of goods at the lowest price and which was heretofore possible to only certain manufacturers—has been made available to all American manufacturers of machinery, vehicles, tools, electrical apparatus, and many other lines of products, through the standardization of limit gages which has just been completed and approved by the American Engineering Standards Committee.

Limit gages, upon which the new standard is based, are simple devices for checking dimensions with great accuracy. The preparation of the standard, which includes the method of using the gages and tables showing the degree of accuracy required in the inspection of parts for different classes of work, was the work of a committee of twenty-one experts under the chairmanship of Colonel Eugene C. Peck, prominent manufacturer of Cleveland. The committee, which was under the official leadership of the American Society of Mechanical Engineers, was a very representative one. Not only the different industrial groups, but the Government participated officially, the latter through the Army and Navy Departments and the Bureau of Standards.

When all American manufacturers use this standard gaging system, parts made by any manufacturer will fit corresponding parts made by any other manufacturer, thus making possible large scale production by any factory.

Lowered Cost of Mail Truck Operation

Interesting facts concerning the vehicular operations of the Post Office Department, brought out in the annual report of the Postmaster General, just submitted to Congress, are as follows:

"The transportation of the mail by means of motor trucks, owned, maintained and operated by the department, has been extended to 552 cities—an increase of 66 cities during the fiscal year 1925.

"A substantial decrease has been made in the expense of operating government-owned trucks during the past three years. The cost of operating an average-size truck (approximately one ton capacity) during the fiscal year 1922 amounted to $1.53 per hour, including the pay of the driver. This expense was reduced to $1.40 per hour in 1923; to $1.32 per hour in 1924, and to slightly less than $1.30 per hour in 1925, exclusive of the salary increase authorized by the act of February 28, 1925. This is a net decrease of twenty-three cents per hour in three years, and the importance of the reduction will be appreciated when it is known that during the fiscal year 1925 government-owned trucks performed 14,368,255 hours of service. This saving was accomplished notwithstanding the salary of the personnel has increased each year since 1922.

"During the fiscal year ended June 30, 1925, the expenditures for government-owned service amounted to $11,570,937 and for contract service $3,761,218 (an increase of $573,475 for government-owned service and $96,115 for contract service), a total of $15,332,155.

"The increase in the expenditures for government-owned service was due to the fact that during the fiscal year 1925 the government-owned trucks traveled 3,912,458 miles and rendered 1,078,740 hours more service than during the preceding fiscal year. The additional expenditure for contract service resulted principally from the hire of vehicles on a temporary basis for use in delivering."

Air Brake Tests Conducted at Purdue

With a view to bringing about still greater safety and comfort to passengers as well as a still greater reduction in loss and damage both to freight and equipment, the American Railway Association is now conducting an elaborate series of tests of train brakes. The purpose of the tests, which are being held at Purdue University, Lafayette, Ind., is to determine what improvements can be made in respect to the present standard of brakes now used by the railroads of this country.

These tests, which have just gotten under way, are being conducted under the direction of H. A. Johnson, general manager of the Chicago Rapid Transit Co., together with a corps of assistants numbering thirty expert engineers. The tests, which will go into every phase of air brake operation, are expected to require more than a year.

In order to enable the engineers to watch closely every phase of the tests, a new recording trainagraph was developed. This instrument records the pressure in the brake pipes, brake cylinder, auxiliary and emergency reservoirs. Pens electrically connected to a master clock automatically indicate the seconds on a chart in order to show the period required from the time the air is applied on the locomotives until the brakes respond under each car. Many other scientific instruments are being used to register certain phases of the tests.

G. E. Defense

In issuing the regular quarterly statement to the stockholders of the company on Jan. 15, the board of directors of the General Electric Co. took occasion to clarify some of the misunderstandings that have been current regarding the position of the organization in the electrical industry.

The statement is in the form of a booklet, which is really an answer to the oft made charge that the General Electric Co. is a monopoly. This booklet clearly states the connections, between G. E. and other electrical manufacturers, power companies and financial interests.

The text goes into detail to explain various phases of the company's business, and includes charts and tables showing the amount of business handled by the company in the past year.

L. W. Wallace Heads Eye Conservation Council

Lawrence W. Wallace has been re-elected president of the Eye Sight Conservation Council of America, which is directing a nation-wide movement for better vision in education and industry. Mr. Wallace is executive secretary of the American Engineering Council, and was vice-chairman of the Committee on Elimination of Waste in Industry, which made a national assay of waste under the direction of Secretary Hoover.

Guy A. Henry was again chosen general-director in charge of the council's headquarters in New York City. Representatives of the Federal and State Governments, universities, engineering societies, and civic bodies will aid in carrying out a 1926 program.

To the board of directors Professor F. C. Caldwell, of the Department of Electrical Engineering, Ohio State University, and Dr. Morton G. Lloyd, of Washington, D. C., chief of the safety section, U. S. Bureau of Standards, were elected. Secretary of Labor James J. Davis was re-elected to the board of councilors.

To Resume Manufacture of Ethyl Gasoline

Following a public health conference at the office of the Surgeon General last week, E. W. Webb, president of the Ethyl Gasoline Corporation, issued the following comment:

"The history of this company has not been that of the usual commercial enterprise. The development of ethylized gasoline was the result of the joint efforts of two of the largest units in the automobile and oil industries. Their common purpose was to provide a better and more efficient motor fuel and thus to conserve a vital natural resource.

"When, after two years of successful progress in this direction, the question of a possible health hazard was raised, the company voluntarily suspended operations pending the investigation of the question by the Surgeon General's committee. Naturally we are gratified by the committee's findings and report. Co-operating with the Surgeon General, and giving full effect to the committee's recommendations, we plan to resume operations."

Canadian Auto Show

With exhibits valued at upwards of $1,000,000, including the latest models of automobiles, 36 different types of trucks and 58 exhibits of accessories, the National Motor Show of Eastern Canada was held in Montreal recently. There were 105 exhibitors, the largest number of motor show participants in the history of the Montreal Automobile Trade Association, under whose auspices the show was held.

Of more than ordinary interest were several excellent working models of engines and chassis, operated by electricity, with cylinder walls and gear housing cut away to show interior mechanism.

China Buys More Machine Tools

The trade of the United States with China in machine tools through the year 1924 (statistics for 1925 are not yet available) increased steadily, according to official Chinese customs statistics. The amount supplied in 1924 was 187,743 Tls (value of teal in 1924 was $0.81) as against a total of only 88,935 for 1923 (value of teal in 1923 was $0.80), and 82,178 in 1922 (value of teal in 1922 was $0.83).

While total imports of machine tools and propelling machinery have held up fairly well during these years, imports of textile machinery have declined greatly, dropping to 5,709,569 in 1924 from totals of 30,480,376 Tls. and 12,316,486 Tls. for the years of 1922 and 1923 respectively. This sharp decrease in imports of textile machinery is largely responsible for the low total of 9,645,102 Tls. for all machinery imports in 1924, representing a decline of 34 per cent from the 1923 total of 14,357,286 Tls., which in turn showed a decrease of almost 58 per cent from the total of 33,779,044 for 1923.

Air-Cooled Commercial Aircraft Engine

A new aircraft engine has been designed exclusively for commercial purposes by Glenn D. Angle, with the assistance of Capt. E. V. Rickenbacker, and is being produced by the newly organized Detroit Aircraft Engine Works. This is a five-cylinder, air-cooled engine which develops 60 hp. at 1,650 r.p.m. and approximately 75 hp. at 2,400 r.p.m. It weighs less than 180 lb. and is equipped with two magnetos. The size of the engine is adaptable to a wide range of applications and several methods of installation. As a single unit it has power for a single seater with a speed up to 125 miles an hour.

Cylinders are cast individually from nickel-iron. Cooling fins are integral, of the circumferential type. Single inlet and exhaust valves are placed directly in the spherical-shaped combustion head. Two spark plugs are provided for each cylinder. Valves are operated through push rods by rockers which are supported on the valve port flanges. The flanges, with rocker arms attached, may each be removed as a unit. Valve tappet clearances may be adjusted at the outer ends of the duralumin push rods. The crankcase is a barrel-shaped aluminum casting containing a cored passage that constitutes the intake manifold. It has a large opening in front to permit the crankshaft and connecting rods being inserted as a unit. This crankshaft has a single throw and with counterweight weighs slightly over 10 lb. It is supported on two ball bearings, the forward bearing carrying the thrust of the propeller. The drop-forged duralumin connecting rods are of the articulated type.

A unique feature of this design is the single ring of three cams which operates all ten valves. Timing of the cams may be quickly effected after the rear cover or breather has been removed. The gear case has integral mounting flanges for the two five-cylinder high-tension magnetos and supports as well the gear and shaft which drives them. The magnetos work independently; one firing the forward spark plugs and the other the rear plugs in all cylinders.

The cylinders extend far into the crankcase and provide an oil sump between the two lower cylinders, sufficient to retain and prevent excess oil from draining into these cylinders before being returned to the tank by the scavenging pump. Gears, pistons, and ball bearings on the crankshaft are lubricated by oil sprayed from the bearings and moving parts.

Consider Machinery Exhibit at Springfield

For some time a committee of the trustees of the Eastern States Agricultural and Industrial Exposition, at Springfield, Mass., has been considering a plan to establish in Springfield an industrial exposition having to do with heavy machinery of all kinds, tools and fixtures, automobiles and automotive equipment, and various other manufactures. It is conceived that such an exposition might be put on each year to advantage in the large permanent buildings of the Eastern States organization. Having this plan in view, Joshua L. Brooks, president, and Charles A. Nash, general manager of the Eastern States Exposition, are sailing from New York on the steamship "Berlin," Feb. 16, to make a study of the annual Industrial Exhibition and Buyers' Fair in Leipzig, Germany. They will endeavor to ascertain what features of the Leipzig fair may be adaptable to the exposition they have in mind.

Research Fellowships at Lehigh University

The announcement by Lehigh University, in Bethlehem, Pa., of two new research fellowships in engineering brings to light an interesting example of the activities of public service industries in research. One fellowship was founded by an endowment fund created by Mrs. Henry M. Byllesby, widow of the late president of the Byllesby Engineering and Management Corporation, who received his degree in mechanical engineering from Lehigh. The other was founded by the New Jersey Zinc Co. Although the subjects to be investigated under the fellowships may be proposed by the donors, the funds are to be administered and the work directed by the institute of research of Lehigh University. In common with all other activities of the institute, the work will follow lines of pure research and the results will be immediately available to the engineering profession.

Half of the time of the fellows must be devoted to research work on some problem in electrical, mechanical or hydraulic engineering, the other half to graduate study. Applications or requests for information should be addressed to President Charles Russ Richards, of Lehigh University.

Navy Approves New Aircraft Engine

The navy 50-hour test for airplane engines was given to the first engine of the Pratt & Whitney Aircraft Co., at the Pratt & Whitney Co.'s plant in Hartford, Conn., and completed on Feb. 2. Commander E. E. Wilson, of the bureau of aeronautics of the Navy Department, was present and declared that the engine has met all the navy requirements.

The test was made on the first engine turned out. A few months ago the announcement of the formation of the aircraft company was made and the designing, building and testing of the engine was completed last week.

The engine is described as the "P. & W. Scout" and is a nine-cylinder, air-cooled radial engine, developing about 400 hp. It is declared to be the lightest engine for its horsepower ever built. The magneto, carburetor, fuel pumps and other parts are at the rear of the engine and protected from exposure.

Designer Chance Vought predicts greater efficiency in range of operations and speed for the engine.

President F. B. Rentschler said that the next step of the aircraft company, would be to build a few more experimental engines and after these are thoroughly tested they will be placed on the market.

Standards Adopted for Die-Chasers and Heads

Another step in the elimination of waste is marked by the adoption of the simplified list of chasers for self-opening and adjustable die-heads, as reported by the general conference held at the Department of Commerce on Dec. 4, last.

Copies of this list are now available at the simplified practice division of the Department of Commerce and should be in the hands of all users of such chasers. As in previous cases this list represents an agreement among makers, distributors and users of these chasers to eliminate many sizes and to discourage the use of special tools wherever possible. The simplification movement deals principally with new production and does not seek to inconvenience users of old equipment. When thoroughly understood, it is indorsed and aided by all who desire economic progress.

Welded Locomotive Tank Proves Efficient

Electric arc welding as a method of constructing locomotive tender tanks, instead of the customary riveting process, offers a prospect of a better product and reduced cost, according to results obtained recently by the Boston & Albany R.R. This road built at its West Springfield, Mass., shops a locomotive tender tank constructed throughout by arc welding equipment, with the exception of the safety appliances. This tank was mounted on a steel frame, and placed in service. It has covered a distance of 201,563 miles with no defects having developed.

The Business Barometer

This week's outlook in Commerce, Finance, Agriculture and Industry based on current developments

By Theodore H. Price
Editor, *Commerce and Finance, New York*

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IN JUST how far the ups and downs of Wall Street affect general business has always been a debatable question and never more so than now. There is, of course, a close relationship between the world of finance and that of commerce, but their moods and movements are not always synchronous and sometimes they seem to be contradictory.

Last week the feeling on the Stock Exchange was reactionary, and like the chameleon the market took its hue from its background. The unfavorable was exaggerated and the favorable ignored. The statement of brokers' borrowings showed that about one tenth of the country's entire bank loans was being used to carry securities. It was inferred that liquidation was in order and when the Government sought to enjoin the formation of the huge baking trust that was in the making the liquidation followed.

The abandonment of other combinations that were being negotiated was thereupon announced and more liquidation ensued.

The view that the bull market in stocks is over with for the present is coming to be generally accepted and it is probable that in the immediate future it will be easier for the pessimists than the optimists to get a hearing. But the ascendancy of the former has not yet affected distributive trade, although it has slowed down speculation on the commodity exchanges.

Thus, wheat has declined in the face of statistical conditions that are indubitably bullish, and corn is easier because there is talk about the impending liquidation of the stocks held in the country elevators.

In the cotton market there has also been an utter lack of speculative initiative and by many the dullness is regarded as the harbinger of a decline.

Coffee, though artificially sustained, has also been inactive, and sugar is the only article that has shown an upward tendency. Wool, though hard to gage, seems to be a little heavy and rubber appears to have lost its resiliency although New York is now provided with two exchanges where rubber may be bought and sold for future delivery.

The dry goods markets are still in a "between seasons" condition, but the offtake has probably been what is called "normal," which is not a very precise term.

The steel industry has been relatively quiet and the production of iron shows a slight decline that is attributed to the fact that coke is worth more for fuel than for iron making.

A settlement of the anthracite coal strike has been agreed to on terms that seem to mean peace without victory for either side. The miners will resume work at once, but the winter will probably be ended before any substantial supply of hard coal becomes available for general consumption.

The Federal Reserve Board reports that as of Feb. 3 the member banks in the New York District were loaning $3,091,997,000 to dealers in securities in that district.

What's Doing in Industry

Sales of machinery and machine tools seem to have reached a steady level at this time of the month. No large orders are reported from any center of industrial activity, but the number of new inquiries from all sources indicates that business will be maintained for some weeks to come.

The East shows decided signs of awakening. The New England territory has experienced a change for the better, orders and inquiries being more numerous and of a better nature. New York reports more inquiries now than for some time past, although actual sales are rather slow in closing.

The South is busy, textile mills and construction interests making frequent purchases of tools and equipment. Philadelphia reports a general improvement in machine tool business.

The Mid-West continues at a satisfactory level, although sales to the automotive industries have slowed up somewhat. Detroit dealers are busy quoting on new inquiries. Chicago reports railroad buying active. Orders from the Pacific Coast and the East have been received in Cincinnati.

The willingness of business all over the country to act with more conservatism and caution is a noticeable feature of the present month. This is not to be regretted as it is admitted that some slackening was necessary to the general health of industrial and financial progress.

Copper is slightly higher, but the change lacks significance. The other metals have not moved much. The outlay for new building during the month of January is said to be the largest on record for that month, but speculative activity in land and new construction seems to be decreasing and in this field, as in the stock market, the music of the recessional is being chanted by many.

The action of the Farm Loan Board at Washington in notifying the Federal Land Banks and the Joint Stock Land Banks that no dividends on their stocks may be paid without the board's approval and that they may not capitalize any increase in the value of property taken in on foreclosure has directed attention to the speculation in the shares of some of the Land Banks.

Installment buying is another inflationary factor that is now evoking much discussion. Estimates of the amount that consumers owe for goods bought on time range all the way from 2 to 4 billion dollars, and some experts who are now making themselves heard insist that when retrenchment becomes necessary the purchasing power of the people will be reduced by the indebtedness they have already incurred as well as by any diminution in their future incomes.

Installment buying is not, however, a novelty. Every one has known of the practice for several years and the chief significance of the present discussion is that it connotes a tendency to look on the darker side of the screen. If we have any recession in business it will be due to this tendency, for it is only in its psychological aspect that the outlook seems at all dubious.

The French franc is again on the decline. It appears to be a case of hope deferred. To the American mind French politics are incomprehensible. In Great Britain the labor issue and the coal question are again forcing themselves to the front. But farther East, in India and China, there appears to be great prosperity despite the political unsettlement, and the English manufacturers in Lancashire and Yorkshire are enjoying a better demand for their goods.

On the whole there is no more trouble in sight than usual, but on both sides of the Atlantic people are a little more willing than they were to look at both sides of the picture. This willingness, which is called conservatism, may breed caution and slow down business activity for a time. Perhaps this is not to be regretted, for the world has been moving very rapidly of late and some slackening of speed for lubrication and repairs will be good for its machinery.

The Industrial Review

Progress of the machinery and machine-tool business in various parts of the country

THE following reports, gathered from the various machinery and machine tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

Chicago

There has been a slight falling off in inquiries for machine tools during the past week, but these are reported by dealers generally still to be satisfactory in point of number. The closing of sales continues to be slow, none of the railroads whose lists have been issued having reached the buying stage. It is the opinion of the larger machine tool houses that the anticipated railroad business, upon which so much is counted, will not materialize for two or three months to come. This situation is accounted for by the fact that the roads are awaiting more bids, a number of which they say are yet pending.

Large manufacturing and industrial interests requiring increased shop equipment are more active in closing, among these being the International Harvester Co., the Nash Motors Co, of Kenosha, Wis., the National Lock Co., of Rockford, Ill., and a number of smaller concerns.

Milling machines continue in good demand, with deliveries improving. Manufacturers of grinding machines and wheels report business as keeping fully up to the average of the last few months. As a whole, the machine tool situation is satisfactory, but it is expected to show improvement as the year advances.

New York

Steadiness is the word that best describes conditions in this market at the present time. There has been little or no change in the past two weeks. Sales are being made with monotonous regularity, and while they are not for large amounts, they nevertheless present a satisfactory total. Single machines for replacement constitute the bulk of orders.

Inquiries are more numerous, industrialists and the railroads being in the market for equipment. The D. & H. and the New York Central have both sent out requests for quotations on fairly good sized lists. The General Electric Co. has also issued a list of requirements.

The second-hand market continues shy of desirable tools, but plenty of standard machines are available. This market is active in a general way.

Cincinnati

The feature of the Cincinnati machine tool market in the past week seems to rest in the fact that more orders and inquiries are reported from the East than from other sections. Of almost equal interest is the report that orders and inquiries have also increased from the Pacific Coast and that business in that section appears to be becoming more active.

Judging from reports of manufacturers and selling agents, a greater amount of business was booked in the past week than in the previous one and a greater number of inquiries were received. It is thought that some of the railroad lists now in hand will be ordered before the month is over and that other lists will be ordered the early part of March.

Industrial users of machine tools are reported to be buying more freely. The number of orders coming from the automotive industries showed an increase. Reports just received that the textile mills are becoming more active lead to the belief that this market will soon open up.

The common feeling among machine tool manufacturers and selling agencies is that the sales possibilities are improving each week and confidence is expressed that the present upward trend will continue. Locally, there is practically no unemployment and general business is in an excellent condition.

Philadelphia

A general improvement in the tone of business in the Philadelphia area was noted this week by machine tool manufacturers and producers of machinery and equipment generally. While new orders forecasting early quantity buying were not noticeably increased, there was a feeling that the good start made in the last two months would continue and that inquiries received over a considerable period will develop into substantial orders.

Dealers in wood-working machinery find a substantial increase in the purchase of their line. Mill work machinery generally has been moving with some briskness, with planing mills leading in inquiries and in buying. Some of the more optimistic machine tool producers express the belief that business is substantially on the upward trend. There are others, however, who hold a less favorable view of the situation, expressing the belief that orders have not kept pace with the advance in other lines.

The belief is held by all, however, that with the approach of March first the trade will settle down to a more substantial basis.

Detroit

Sales of machine tools and machinery remain at the same level maintained for the past few weeks. Few building programs of any great size are scheduled among the automobile companies, and as a consequence representatives of machinery manufacturers are not expecting any large orders of consequence from the automotive industry.

At the same time market conditions in other industries centering in Detroit are better than for some time. This is especially noticeable in the railroad field. The Pennsylvania, Grand Trunk and Pere Marquette have announced lists of equipment which will be purchased soon. Other lines are buying tools in various quantities.

The stove and adding machine factories are proving to be better markets than for some time, while several of the rolling mills are ordering new equipment.

Used tools are moving at only a fair rate, engineers preferring to order new equipment, except in cases of emergency.

The recent price reduction in all Ford closed cars is likely to mean heavy buying for some of the departments at the Highland Park and River Rouge plants, which are not machined up for the production which is expected to follow this price reduction.

Officials of the Cadillac Motor Car Co. are working on plans for additions which will enable the plant to step-up production about 30 per cent, and machine tool men expect that Cadillac will be among the heaviest buyers of machinery during the next few months.

In spite of a decline in sales this year over the record established last fall, leaders in the field expect the first half of 1926 to be better than the corresponding period last year.

Employment is very close to the highest it has ever been in this city, figures of the Employers' Association showing considerably over 260,000 employed in major plants of Detroit.

New England

Machinery builders in the Connecticut section of New England report further improvement in business. Orders actually placed for the most part represent business held over from last year, and are for early deliveries and are for replacement in most instances.

It is the concensus of opinion of manufacturers that there is only a small volume of business in this section for expansion, immediate or near future. The requirements indicated in the general demand for the past fortnight are suggestive of a better outlook for the electric industry, railroads and for the automotive and accessory trades.

The period of annual meetings is at hand by industries in this section and the analysis of accounts shows cause for satisfaction in the increased profits and the volume of business. There are no indications of higher prices, but in some quarters it appears that managements are setting their houses in order to net better profits through economies in operations.

Southern District

Machine tool and equipment sales in the Southeastern territory still appear to be marking time, dealers reporting inquiries active enough but sales so far showing little improvement. They are, however, decidedly optimistic over the outlook for spring, and believe present inquiries will develop good business within the next two or three weeks.

A slight improvment is seen in textile demand, principally from new cotton mills that are being constructed, or from existing companies that are building additions. Considerable of this work is in progress in the Georgia and Carolina territory. Sales to this source the first half of the year seem certain to prove better than they were the first half of 1925.

Woodworking machinery has quieted down a little, and is less active than it was the latter part of January. The lumber and furniture industries, however, are enjoying a heavy demand, and all indications promise good sales to this field during the spring and summer, particularly in the furniture industry in North Carolina.

Smaller machine shops are not buying on a very good basis, though dealers report a few orders are being received from this source, mostly for used or rebuilt equipment. Sales of equipment to service stations have fallen off in the past two or three weeks, though a few sales of drill presses, cylinder grinders, lathes and similar machinery are being made.

Road equipment and contractors' machinery are both picking up steadily. Dealers are confident that this business will establish another record volume the coming spring and summer. Sales of road building machinery are expected to be especially heavy in the Florida, Georgia and North Carolina territory. Railroads are buying heavy equipment on about the same basis as two weeks ago, though inquiries from this source seem to be picking up.

What the Railroads Are Doing

While there has been a decided improvement in purchases of cars by railroads, demand for locomotives continues quiet. One or two good sized inquiries made their appearance recently but total orders for engines in the market for domestic roads is probably not in excess of 60. There is also some foreign business before American builders.

Continued dearth of locomotive business is attributed to the longer average train hauls in the past year or two. This has made it possible for each engine to do more work than it formerly did. On the other hand, it is claimed the wear and tear on locomotives is greater than it ever was before, for the same reason, and it is only a question of time when a heavy replacement demand will be seen.

The New York Central R.R. has released approximately 50,000 tons of rails under option. About 30,000 tons will go to Chicago makers.

The St. Louis Southwestern R.R. is reported to have ordered 14,000 tons of rails. A number of smaller lots ranging from 3,000 to 5,000 tons were placed with Western builders.

The Southern Ry. has ordered the repair of about 2,500 cars by the Mt. Vernon Car and Manufacturing Co.

The American Locomotive Co. has received orders from the Florida East Coast Railway Co., for six eight-wheel switching locomotives, weighing 219,000 pounds each, and from the Modesta and Empire Traction Co., of Modesta, Cal., for one Mogul type locomotive, weighing 88,000 pounds.

News of the Automotive Industry

Prosperity for the automobile industry in Detroit for the first seven months of the fiscal year 1926 is indicated by figures compiled by Fred L. Woodworth, collector of internal revenue. From July 1, 1925, to February 1, 1926, the first seven months of the fiscal year, excise taxes collected on automobile sales totaled $51,745,837. The tax for last year totaled $70,690,740.

The excise taxes, which levy 3 per cent on the sales price of trucks and 5 per cent on pleasure cars, show an average gain of approximately $1,500,000 a month over the 12 months of 1925, despite the fact that the months from July to January are rated the dullest from a sales standpoint in the automotive industry. The average monthly tax collected for the first seven months of the present fiscal year totals $7,392,262.

The General Motors Corporation announced last week that it had sold 835,749 automobiles in 1925, the types being Chevrolet, Oldsmobile, Oakland, Buick and Cadillac. Of this number approximately one-fourth were driven away from the plants and the remainder sent by railroads.

Freight cars required to bring raw materials into the General Motors plants and carry away the finished automobiles totaled 380,704 in 1925, compared with 280,051 in 1924 and 340,337 in 1923. Freight charges were $57,000,000.

The name of the Nordyke & Marmon Co. has been changed to the Marmon Motor Car Co. Officials of the company remain the same, with W. C. Marmon chairman of the board, and G. M. Williams president and general manager.

The Marmon Motor Car Co. operates two subsidiary companies, the Marmon Automobile Co. of New York, Inc., and the Marmon-Detroit Co.

According to Mr. Williams, last year's production was by far the largest in the history of Marmon, and orders now on hand, combined with a conservative analysis of the demand, indicate a reasonable expectancy of 20 per cent increase in sales during the next twelve months.

The Oakland Motor Car Co. is making plans to add approximately 600 employees to its force of 3,000, bringing the number to the highest point in history of the company, equaled only in the boom year 1919.

While factory officials deny that Hudson prices have been increased, it is believed that a radical change in merchandising policy will soon take place. Extra equipment will be included in the retail price, and the retail price will be f.o.b. at the city where the car is actually sold.

Personals

R. H. SMITH has been elected treasurer of the Kent Machine Co., Kent, Ohio.

E. T. KNOBLOCH has been appointed Philadelphia representative for the Union Iron Works.

H. T. FOSTER, formerly of the Ingersoll-Rand Co., of New York, is now associated with the Steel Products Co., of Detroit.

WALTER M. COE, mechanical superintendent at the Standard Steel and Bearing Co., Plainville, Conn., has resigned.

RENE A. WURGEL has become chief engineer and superintendent of purchasing for the Holly Pneumatic Systems Co., New York..

HAROLD N. BLAKE has been appointed mechanical superintendent of the reduction department for the Anaconda Copper Mining Co., at Great Falls.

EDWARD F. GEER has been elected vice-president of the Underwood Typewriter Co., Inc., Hartford, Conn., to succeed the late Clinton L. Rossiter.

K. O. BITTER, formerly of the American Machine and Foundry Co., is now general superintendent of the lithographic plant of H. Gamse & Bro., of Baltimore.

J. T. TRUMBLE, assistant chief engineer of the Olds Motor Works, Lansing, Mich., for the past three years, has resigned to become chief engineer for the F. B. Stearns Co., motor car maker, of Cleveland.

T. HOLLAND NELSON, steel expert, has become associated with the Ludlum Steel Co., Watervliet, N. Y. He will act in an advisory capacity in the production of rust and corrosion resisting iron and steel. Mr. Nelson is also vice-president of the Wm. T. Bate & Sons Co., of Conshohocken, Pa.

J. H. HORIGAN has been elected secretary and a director of the Union Twist Drill Co., of Athol, Mass. Mr. Horigan has been associated with this company and its predecessors for the past twenty-five years, advancing from the position of errand boy to that of chief tool engineer of the company.

H. H. SNELL, formerly manager of the gear department for the Chas. Bond Co., of Philadelphia, has been appointed district representative for the Foote Bros. Gear and Machine Co., of Chicago. His territory covers eastern Pennsylvania, Delaware, Maryland and the southern half of New Jersey. The Chas. Bond Co., former representatives for the Foote Bros. Gear and Machine Co., will continue to handle the line as jobbers.

Business Items

The Scoville Manufacturing Co., Waterbury, Conn., has acquired the capital stock of the Gilchrist Co., of Newark, N. J. The business will be continued at Newark.

The L. H. Gilmer Co., manufacturer of woven products, has taken over a number of unfilled contracts for small rubber belts from the United Globe and Rubber Co., of Trenton, N. J.

The Milwaukee Machinery Co., of 93 West Water St., Milwaukee, has been appointed sales representative in the Wisconsin territory for the tools manufactured by Bardons & Oliver and by the Loshbough-Jordan Co.

The Albany Machinery Co. has been organized at Albany, Ga., establishing offices and a warehouse at 108 Pine St., for the distribution of machine tools and general equipment in the Georgia and part of the Southeastern territory. The company also has a used machinery department.

The Barber Asphalt Co., of Philadelphia, has taken over the exclusive rights to manufacture "Aterite" an alloy metal previously controlled by the Aterite Co., of New York. The production will be confined to the Barber company's plant at Buffalo, N. Y.

Henry Disston & Sons, Inc., of Philadelphia, announce the appointment of E. A. C. Baum as assistant Western representative for steel sales, with headquarters at the Disston Chicago branch, 111 North Jefferson St. Mr. Baum formerly was metallurgical engineer with the Illinois Tool Co.

The Timken Roller Bearing and Sales Service Co. has opened a branch in Cincinnati at Ninth and Sycamore St., with J. M. Heffelfinger, formerly of Indianapolis, in charge, and B. F. Kiefer in charge of industrial sales. It is planned to cater especially to the machine tool industry, with special service.

The National Electric Manufacturing Co., Pittsburgh, manufacturer of motorless electric hammers, announces the following new offices and managers: the Syntron-Boston Co., John L. Shea, manager, 308 Congress St., Boston; the Syntron-Detroit Co., E. Earl Beatty, manager, 5001 S. Clarendon St., Detroit.

The Green Bay Drop Forge Co., located at Green Bay, Wis., is the new name given to the reorganized firm formerly known as the Green Bay Drive Calk Co., manufacturer of automobile forgings. The company has purchased the old plant of the Conradson Machine Tool Co., at Green Bay, and is making plans to increase production.

The financial interests of the Hewitt Rubber Co., of Buffalo, and the Gutta Percha and Rubber Co., of Brooklyn, N. Y., have been merged and the entire production of the two organizations will be concentrated at the plant of the former company in Buffalo. F. E. Miller has been elected president of the reorganized firm. The Brooklyn plant of the Hewitt company will be abandoned, but branch offices throughout the country will be continued as heretofore.

The Crescent Tool Co. of Jamestown, N. Y., has purchased the entire capital stock of the Smith & Hemenway Co., Inc., of Irvington, N. J. Landon P. Smith, president of the latter company, has retired from active business. The glazers' tool business of the Smith & Hemenway company has been transferred to L. P. Smith, Inc., at Irvington, N. J., but the rest of the products of the company will be manufactured and sold as heretofore by Smith & Hemenway.

Bühling & Klingelnberg, of Anhaltstrasse 5, Berlin, S.W. 11, Germany, has just been organized with Max Bühling as the general manager. The company will handle a comprehensive line of machine tools and is expressly desirous of obtaining connections with American manufacturers. Through an established connection with the firm of W. Ferd Klingelnberg Sohne, at Remscheid, the new company has at its disposal ten branch sales offices throughout the principal large cities in Europe.

At the annual meeting of the stockholders of the Northern Engineering Works, manufacturers of electric traveling cranes, hoists and foundry equipment, of Detroit, the following officers and directors were elected for the ensuing year: Henry W. Standart, president and treasurer; Harry C. Bulkley, vice-president; Louis H. Olfs, secretary. The above, with W. Robertson, chief engineer of the company, and Joel H. Prescott, constitute the board of directors.

Obituaries

HENRY LOCKWOOD, founder of the Lockwood Manufacturing Co., lock manufacturers, at Norwalk, Conn., died last week. He was president of the City National Bank of Norwalk.

WALTER BOHRER, president of the Monarch Tool and Manufacturing Co., of Cincinnati, died on Feb. 9, after an illness of but two days. After graduating from Cornell in 1905, Mr. Bohrer entered this business and he had not been absent from his desk a single day in eighteen years.

JOHN JACOB BAUSCH, founder and president of the Bausch & Lomb Optical Co., of Rochester, N. Y., died at his home in that city on Feb. 14. He was 95 years old. Mr. Bausch was born in Gross Suessen, Germany, and came to America when he was nineteen years old. Shortly after his arrival he settled in Rochester and there began the optical business which has grown to be one of the largest in that industry.

Trade Catalogs

Blowers and Exhausters. American Blower Co., Detroit, Mich. Bulletin No. 1608, sixteen 8½x11-in. pages describes the type P "ABC" pressure blowers and exhausters. The principles of operation of the type P blowers and their advantages are detailed. Tables show the capacities applicable to the average forges, furnaces and cupolas as well as to ventilation service. The construction of the blowers is completely covered in this bulletin.

Chains and Sprockets. Diamond Chain & Manufacturing Co., Indianapolis, Ind. Catalog No. 57, eighty-four, 6x9-in. pages, on Diamond chains and sprockets has been published by this company. The catalog explains the nomenclature of roller and block chains. Definitions of terms used in the text are given at the outset. Fourteen pages of photographs show applications of the roller chains in many industries.

The remainder of the catalog is devoted to a listing of the various types of roller block and special chains as well as sprockets made by the company. Full-size illustrations and dimensional line drawings are given. Tables show the specifications for the sprockets. The formulas used in the design of the sprockets are worked out. Several pages of other useful information in connection with chains are appended.

Chucking Machines. The Gisholt Machine Co., 1000 East Washington Ave., Madison, Wis., has issued a circular on two production jobs done on the "Simplimatic." The time record is given as well as drawings of the parts that were machined. Other examples of work are also shown by means of drawings.

Chucks, Magnetic. O. S. Walker Co., Inc., Worcester, Mass. Circular T1 illustrates and describes several models of magnetic chucks for heavy-duty face and surface grinders, milling machines and planers. Illustrations show various applications of the chucks. Other standard products of the company are illustrated and the model D single-stroke surface grinding machine is briefly described.

Cutters and Collets. The Reed-Prentice Co. is distributing Circular 27-202-1 on milling and engravers' cutters and collets for Becker Nos. 2A and 3 vertical milling machines. Illustrations and specification tables are included.

Dieheads. The Eastern Machine Screw Corporation, 23-43 Barclay St., New Haven, Conn. A catalog containing seventy, 6x9-in pages on "H & G" self-opening dieheads, and entitled "Revolutionized Threading" has been published by this company. The opening pages are devoted to a general discussion of the adaptability and construction of the dieheads and to a description of the chasers.

The styles A and AA, rotating; the styles C and CC, non-rotating; and the small non-rotating style D are individually treated. The descriptions include views of practical applications of the dieheads as well as illustrations and lists of the parts of each. Four pages are devoted to the "H & G" threading machine and the chaser grinder. The appendix includes a reprint from the report of the National Thread Commission on thread classification. Many useful tables and thread formulas are given.

Drills and Reamers. The Whitman & Barnes Manufacturing Co., Akron, Ohio, has issued a folder on "Hercules" drills and reamers, featuring their use by the Warner Gear Co.

Drill Rods. Firth-Sterling Steel Co., McKeesport, Pa. The February 1926 price list for Globe polished drill rods, Blue Chip high-speed steel drill rods, Firth-Sterling stainless steel rods and Firth-Sterling stainless iron rods, has been issued.

Electrical Equipment. The General Electric Co., Schenectady, N. Y., has published its bi-annual catalog No. 6001-B. This edition has one thousand one hundred and four pages, 8x10½ in., cloth bound, and over three thousand two hundred illustrations. It has thumb-indexed sections covering generation; wire and cable; distribution transformers; arresters; voltage regulators; switchboards, devices and accessories; meters and instruments; motors and motor applications; industrial control; railway; lighting; industrial heating and miscellaneous. There is also a subject and a catalog number index.

The illustrations include photographs of nearly all the material and drawings wherever necessary to show the specifications or wiring of apparatus. The specifications are very complete throughout. The explanations are to the point but sufficiently thorough. The purposes, construction, features and operation of all equipment are included in the description.

The material throughout is well organized and the style is attractive in its plainness and directness. The text is concise and well written. The catalog reflects care and labor in its preparation and arrangement and will be found a useful encyclopedia on electrical equipment especially for industrial purposes.

Goggles. The Safety Equipment Service Co., 1228 St. Clair Ave. N.E., Cleveland, Ohio, has issued a circular on its "Drednaut" and "Super-Drednaut" goggles for industrial use.

Hobbing Machines. Gould & Eberhardt, Newark, N. J., have published their Bulletin No. 148 on the 16 HS manufacturing hobbing machine. The bulletin has twenty-four, 8½x11-in. pages. The basic principles of design and construction are first shown. Details and features of the machine are then outlined. Illustrations of the hobbing machines are included as well as views and explanations of production examples.

Metal Finishing. Metal Finishing Division of the Pyrene Manufacturing Co., 560 Belmont Ave., Newark, N. J. A circular has been issued covering the various methods for the finishing of metals used by this company. These include plating and rust-proofing.

Metallographic Equipment. Bausch & Lomb Optical Co., Rochester, N. Y. A catalog has been published on the model GB-ILSAA metallographic outfit. The catalog includes a very full and complete description of the principles and operation of the equipment and a description of the features of the machine. Specifications and prices of all parts are listed.

Nuts, Bolts and Bars. The Milton Manufacturing Co., Milton, Pa., has prepared its Catalog No. 29, containing one hundred, 5x7½-in. pages. The catalog is thumb indexed and includes descriptions and specifications for nuts, hot-pressed; large nuts; cold-punched nuts; semi-finished, case-hardened, slotted S.A.E. nuts; machine and blank bolts; lag, coach, stud and hanger bolts; tap bolts and tie rods; track, heel and special bolts; rivets and washers. Many useful tables are included.

Phosphor-Bronze. The Phosphor-Bronze Smelting Co., 2200 Washington Ave., Philadelphia, Pa., has issued its price list No. 29. Tables are given of the various forms and sizes in which the metal can be had. These include ingots and casting mixtures; rolled and drawn rods, rectangular shapes and plates; anti-friction and hardening metal; cast and turned rods and bearing metal bushings.

Press Work. "Steelprest—Common Sense in Steel Dollars" is the title of a booklet published by the Heintz Manufacturing Co., Front St. and Olney Ave., Philadelphia, Pa. The booklet has many illustrations and notes on fabrication by stamping and welding. It contains sixteen, 6x9-in. pages, attractively prepared.

Respirators. The Safety Equipment Service Co., 1228 St. Clair Ave., N.E., Cleveland, Ohio, has published a circular on the Willson "Dustite" respirators which it is marketing for use under dusty work conditions or when spraying.

Shapers. The R. A. Kelly Co., P. O. Box 488, Xenia, Ohio, has published an attractive catalog on its crank shapers. The details and features of construction are briefly discussed and illustrations and full descriptions with specifications follow on the Series A, B, C, D and F crank shapers.

Torches, Welding. The Alexander Milburn Co., Baltimore, Md. A twelve-page 8½x11-in. section on Milburn cutting and welding torches, for insertion in a loose-leaf cover, has been issued by this company. Several models of torches are described and illustrated. One page is devoted to welding and another to special torches.

Calendar of Local Meetings

National Association of Cost Accountants

San Francisco. Feb. 22. "How Can the Engineer and the Cost Accountant Co-operate for Better Management?"

Scranton. Feb. 23. Scranton Club. "Changes in the 1925 Revenue Act."

Boston. Feb. 25. "Some Debatable Points in Cost Accounting," by Clinton H. Scovell.

Buffalo. Feb. 25. "Distribution Costs."

Detroit, Feb. 25. "Computing and Distributing Power Costs."

American Society for Steel Treating

Hartford. June. Spring sectional meeting.

American Society of Mechanical Engineers

Atlanta. Feb. 23. Student meeting, afternoon and evening. Session devoted to wood industries.

Metropolitan. Feb. 24. Engineering Societies' Building, New York. "By-Product Processing of Coal," by H. W. Brooks.

Newark, N. J. March 3. "Economic Aspects of Buying and Replacing Machine Tool Equipment."

New York. March 4. Engineering Societies' Building. "Water Purification for Textile Processes."

Society of Automotive Engineers

Chicago Section. Feb. 19. "Soothing the Internal Comoustion Engine," by Professor Daniel Roesch.

Buffalo Section. Feb. 23. "Progress in Airplane Engine Design," by Arthur Nutt.

Detroit Section. Feb. 25. "Airplane Engine Maintenance," by Lieut. Cyrus Bettis.

Forthcoming Meetings

American Management Association. Annual convention, Hotel Astor, New York City, March 3, 4 and 5. Headquarters, 20 Vesey St., New York City.

National Railway Appliance Association. Annual meeting and exhibition, Coliseum and Annex, Chicago, March 8 to 11th. C. W. Kelley, secretary, 845 So. Wabash Ave., Chicago.

National Foreign Trade Council. Thirteenth national foreign trade convention, Charleston, S. C., April 28, 29 and 30. O. K. Davis, secretary, India House, Hanover Square, New York.

American Gear Manufacturers' Association. Tenth annual meeting, Book-Cadillac Hotel, Detroit, May 13, 14 and 15. T. W. Owen, secretary, 2443 Prospect Ave., Cleveland, Ohio.

American Supply and Machinery Manufacturers' Association. Annual convention, Hotel Statler, St. Louis, week of May 17. F. D. Mitchell, secretary, 1819 Broadway, New York.

National Association of Purchasing Agents. Eleventh annual convention and exposition, Ambassador Hotel and Auditorium, Los Angeles, Calif., June 9 to 12. W. L. Chandler, secretary, Woolworth Bldg., New York.

American Society for Testing Materials. Twenty-ninth annual meeting, Chalfonte-Haddon Hall Hotel, Atlantic City, N. J., June 21 to 25. C. L. Warwick, secretary, 1315 Spruce St., Philadelphia.

The Weekly Price Guide

Rise and Fall of the Market

Iron and Steel—Iron buying continues slow with little change in prices during the week. Steel structurals, pipe, and wire products are in good demand; no marked activity, however, is shown in plates. During the past two weeks, prices on the principal hot-rolled products have been as follows: bars, $2; shapes, $1.90@$2; plates, $1.80@$1.90, per 100 lb. at Pittsburgh mills. Furnace coke jumped up another dollar per ton at Connellsville during the week.

Non-Ferrous Materials—Tin advanced 1¼c. and copper, ⅛c. per 100 lb. at Pittsburgh mills. Furnace coke jumped up an- Feb. 13. Lead holds firm while zinc shows a drop of ⅛c. per lb. from last week's level. Higher prices quoted for scrap non-ferrous metals this week, reflect improvement in the market for new metals. Linseed oil continues its downward course in New York and Chicago.

(All prices as of Feb. 13)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b.:

CINCINNATI	
No. 2 Southern	$24.05
Northern Basic	24.27
Southern Ohio No. 2	24.27
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 2.25@2.75)	28.37
BIRMINGHAM	
No. 2 Foundry	22.00@23.00
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	24.16
Virginia No. 2	29.17
Basic	23.16
CHICAGO	
No. 2 Foundry local	23.00
No. 2 Foundry, Southern (silicon 2.25@2.75)	26.55
PITTSBURGH, including freight charge ($1.76) from Valley	
No. 2 Foundry	22.27
Basic	22.27
Bessemer	22.27

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb.:

Detroit	5.00@5.50
Cleveland	5.00@5.25
Cincinnati	5.00@5.50
New York	5.25@5.50
Chicago	5.25@5.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots.

Blue Annealed	Pittsburgh Mill Base	New York	Cleveland	Chicago
No. 10	2.50	3.89	3.25	3.50
No. 12	2.55	3.94	3.30	3.55
No. 14	2.60	3.99	3.35	3.60
No. 16	2.70	4.09	3.45	3.70
Black				
Nos. 18 to 20	3.15	4.30	3.90	3.90
Nos. 22 to 24	3.20	4.35	3.95	3.95
Nos. 26 and 27	3.25	4.40	4.00	4.00
No. 28	3.35	4.50	4.10	4.10
Galvanized				
No. 10	3.50@3.60	4.50	4.25	4.25
Nos. 12 to 14	3.60@3.70	4.60	4.35	4.35
No. 16	3.75@3.85	4.75	4.50	4.50
Nos. 18 to 20	3.90@4.00	4.90	4.65	4.65
Nos. 22 to 24	4.05@4.15	5.05	4.85	4.80
Nos. 26 and 27	4.20@4.30	5.20	5.10	4.95
No. 28	4.50@4.60	5.50	5.25	5.25

WELDED STEEL PIPE—Warehouse discounts are as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
1 to 3 in. steel butt welded	53%	39%	55½%	43½%	54%	41%
2½ to 6 in. steel lap welded	48%	35%	53½%	40½%	51%	38%

Malleable fittings: Classes B and C, banded, from New York stock sell at list plus 4% less 5%. Cast iron, standard sizes, 36-5% off.

Size, Inches	List Price per Foot	Diameters Inches External	Diameters Inches Internal	Thickness Inches
1	$0.17	1.315	1.049	.133
1¼	.23	1.66	1.38	.14
1½	.27½	1.9	1.61	.145
2	.37	2.375	2.067	.154
2½	.58½	2.875	2.469	.203
3	.76½	3.5	3.068	.216
3½	.92	4.0	3.548	.226
4	1.09	4.5	4.026	.237
4½	1.27	5.0	4.506	.247
5	1.48	5.563	5.047	.258
6	1.92	6.625	6.065	.28

SEAMLESS STEEL TUBING—Following net prices are for seamless mechanical tubing, cold drawn, round, .10 to .30 carbon, at warehouse in lots of less than 100 ft.:

Thickness Decimal	B.W.G. and Fractions	Outside Diameter in Inches ⅛	¼	⅜	½	1	1½	1¼
		Price per Foot						
.035″	20	$0.15	$0.16	$0.17	$0.18	$0.19	$0.21	$0.23
.049″	18	.17	.18	.19	.20	.21	.23	.25
.065″	16	.19	.20	.21	.22	.23	.25	.27
.083″	14	.20	.22	.23	.24	.25	.27	.29
.095″	13	.21	.23	.25	.26	.27	.29	.31
.109″	12	.22	.24	.26	.27	.28	.30	.32
.120″ or .125″	11	.23	.25	.27	.28	.29	.31	.33
.134″	10	.24	.26	.28	.29	.30	.32	.34

MISCELLANEOUS—Warehouse prices in cents per pound in 100-lb. lots:

	New York	Cleveland	Chicago
Spring steel (light) (base)*	7.00	6.00@7.50	4.65†
Spring steel (heavier)	4.00	....	4.00
Coppered Bessemer rods (base)	6.05	6.00	6.20
Hoop steel	4.49	3.85	4.15
Cold rolled strip steel	6.25	6.35	6.80
Floor plates	5.55	5.60	5.50
Cold drawn shafting or screw	4.00	3.90	3.60
Cold drawn flats, squares	4.50	4.40	4.10
Structural shapes (base)	3.34	3.20	3.10
Soft steel bars (base)	3.24	3.10	3.00
Soft steel bar shapes (base)	3.24	3.11	3.10
Soft steel bands (base)	3.99	3.20	3.65
Tank plates (base)	3.34	3.40	3.10
Bar iron (3.00 at mill)	3.24	3.21	3.00
Drill rod (from list)	50@60%	55%	60%

Electric welding wire, New York, ⅜", 8.25c.; ¼, 7.85c.; ⅛" to ¼, 7.35c. per lb. *Flat, 1/16@⅛-in. thick. †F.o.b. cars.

METALS

Current Prices in Cents Per Pound

Copper, electrolytic (up to carlots), New York			15.50
Tin, 5-ton lots, New York			65.50
Lead (up to carlots) E. St. Louis	9.10	New York	9.75
Zinc (up to carlots) E. St. Louis	7.80	New York	9.00

	New York	Cleveland	Chicago
Antimony (Chinese), ton spot	23.50	24.50	26.00
Copper sheets, base	22.50	22.50	22.50
Copper wire, base	19.62½	16.50	16.25@16.50
Copper bars, base	22.12½	22.37½	22.12½
Copper tubing, base	24.25	24.50	24.50
Brass sheets, base	18.87½	18.62½	19.12½
Brass tubing, base	23.50	23.25	23.75
Brass rods, base	16.62½	16.50	16.87½
Brass wire, base	19.37½	19.12½	19.62½

Shop Materials and Supplies

METALS—Continued

	New York	Cleveland	Chicago
Aluminium ingots, 98 to 99%, 1 to 15 ton lots	27.00	27.00	27.02
Zinc sheets (casks)	12.00	12.60@12.95	12.27
Solder (½ and ½), (case lots)	39.25	41.00	38@42

Babbitt metal, delivered, New York, cents per lb.:

Genuine, highest grade	78.00
Commercial genuine, intermediate grade	56.00
Anti-friction metal, general service	31.50
No. 4 babbitt (f.o.b.)	14.50

Nickel, f.o.b. refinery, cents per lb.:
Ingots..... 31.00 Electrolytic.. 38.00 Shot..... 32.00

SPECIAL NICKEL AND ALLOYS—Price in cents per lb., f.o.b. Huntington, W. Va.:

Hot rolled nickel sheet (base)	52.00
Cold rolled nickel sheet (base)	60.00
Hot rolled rods, Grade "A" (base)	50.00
Cold drawn rods, Grade "A" (base)	58.00
Manganese nickel hot rolled rods "E"—low manganese (base)	54.00
Manganese nickel hot rolled rods "D"—high manganese (base)	57.00

Base price of Monel metal in cents per lb., f.o.b. Huntington, W. Va.:

Shot	32.00	Hot rolled rods (base)	40.00
Blocks	32.00	Cold drawn rods (base)	48.00
Ingots	38.00	Hot rolled sheets (base)	42.00
Cold rolled sheets (base)			50.00

OLD METALS—Dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Crucible heavy copper	12.00@12.25	11.25	11.50@12.00
Copper, heavy, and wire	11.50@12.00	11.50	11.00@11.50
Copper, light, and bottoms	9.75@10.25	9.50	10.00@10.50
Heavy lead	6.00@6.25	7.50	7.75@8.25
Tea lead	5.50@6.00	5.00	6.75@7.25
Brass, heavy, yellow	7.50@7.75	7.25	7.75@8.25
Brass, heavy, red	9.50@10.00	9.50	8.75@9.25
Brass, light	6.00@6.50	6.00	7.25@7.75
No. 1 yellow rod turnings	8.50@9.00	8.00	7.75@8.25
Zinc	4.75@5.00	4.75	4.75@5.25

TIN PLATES—American Charcoal—Bright—Per box

		New York	Cleveland	Chicago
"AAA" Grade: IC,	14x20	$11.25	$11.45	$11.50
"A" Grade: IC,	14x20	8.85	9.40	9.50
Coke Plates—Primes—Per box 100-lb.,	14x20	6.45	6.10	7.00
Terne Plates—Small lots, 8-lb. Coating—Per box IC,	14x20	7.85	6.95	7.50

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.	$0.15@0.22	$0.19	$0.20
Cotton waste, colored, per lb.	.10@.15½	.10	.17
Wiping cloths, washed white, per lb	.18	36.00 per M	.16
Sal soda, per 100 lb. keg	2.25	2.25	2.75*
Roll sulphur, per 100 lb. keg	3.75	3.35	5.00
Linseed oil, per gal., 5 bbl. lots	.87¾	1.05	.88
Lard cutting oil, 25% lard, per gal.	.55	.50	.56
Machine lubricant, medium-bodied (50 gal. wooden bbl.), per gal.	.35	.35	.29

Belting—Present discounts from list in fair quantities (½ doz. rolls).

Leather—List price, 24c. per lin. ft. per inch of width for single ply.			
Medium grade	40–5%	40–5%	40–5%
Heavy grade	30–10%	30–10%	30–10%
Rubber transmission, 6-in., 6 ply, $1.83 per lin. ft.			
First grade	50%	50–10%	50%
Second grade	50–10%	60–5%	50–10%

*In 175 lb. kegs.

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars	per lb.	$0.0324	$0.0324	$0.0324
Cold drawn shafting	per lb.	.04	.04	.0415
Brass rods	per lb	.1662½	.1687½	.1762½
Solder (½ and ½)	per lb.	.3925	.4025	.42
Cotton waste	per lb.	.15@.22	.15@.22	15@22
Washers, cast iron (½ in.)	per 100 lb.	7.00	7.00	6.50
Emery, disks, cloth, No. 1, 6 in. dia.	per 100	3.55	3.55	3.38
Lard cutting oil	per gal.	.55	.55	.60
Machine oil	per gal.	.35	.35	.29
Belting, leather, medium	off list	40–5%	40–5%	40–2½%
Machine bolts up to 1x30 in.	off list	40%	40%	45%

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials—In sheets 9x11 in., No. 1 grade, per ream of 480 sheets:			
Flint paper	$5.56	$5.84	$5.65
Emery paper	10.71	11.00	10.71
Emery cloth	29.48	31.12	29.48
Emery disks, 6 in. dia., No. 1 grade, per 100:			
Paper	1.49	1.45	1.49
Cloth	3.55	3.55	3.20
Fire clay, per 100 lb. bag		.60	.75
Coke, prompt furnace, Connellsville	per net ton	11.00@12.00	
Coke, prompt foundry, Connellsville	per net ton	13.50@14.00	
White lead, dry or in oil	100 lb. kegs	New York, 15.25	
Red lead, dry	100 lb. kegs	New York, 15.25	
Red lead, in oil	100 lb. kegs	New York, 16.75	

SHOP SUPPLIES

Machine bolts, ¼x1½-in., per 100, $1.70. Discount at New York warehouses on all sizes up to 1x30-in., 40%; 1⅛ and 1¼x3-in. up to 12-in., 15%; with cold punched hex. nuts up to 1-in. dia. (plus std. extra of 10%) 30%; with hot pressed hex. nuts up to 1x30-in. (plus std. extra of 10%) 35%.

Carriage bolts, ¼x1½-in., per 100, $1.00. Discount on all sizes up to 1x30-in., 30%.

Coach and lag screws, 1½x$\frac{7}{16}$in., $2.25 per 100, less 40%.

Tap bolts, 1½x¼-in., $1.00 per 100. List plus 35% at New York warehouses.

Bolt ends, 1x12-in., 10c. per lb., less 40%.

Nuts, semi-finished, ¼x¼-in., 2c. each. Discount 70% for $\frac{3}{16}$-in and smaller and 65% for ¼-in. and larger.
Case hardened ¼x¼-in., 6c. each, less 50%.

Rivets, button heads, ¾-in., ⅞-in., 1-in. diam. x2$\frac{7}{16}$-in. to 6$\frac{1}{16}$-in. $5.00* per 100 lb. at New York warehouses; cone heads, same sizes, $5.20* per 100 lb. Rivets, $\frac{7}{16}$x1-in. and longer, 19c. per lb., less 50%. Same discount for tinned. EXTRA per 100 lb. for 1¼ to 2-in. long, all diameters, 25c.; ⅝-in. dia., 35c.; ½-in. dia., 75c.; 1-in. long and shorter, 75c.; longer than 5-in., 50c.; less than 200 lb., 50c.; countersunk heads, 45c.

Washers, cast iron, ⅜-in., $7.00* per 100 lb. at New York warehouses; ½-in., $6.00* per 100 lb.

*For immediate delivery from warehouse.

Machine Requirements and Industrial Construction

Machine Tools and Equipment Wanted

Calif., San Francisco—L. S. Leary, City Purch. Agt., takes bids until Feb. 23, for manual training equipment, tools and machinery for school departments.

Ill., East St. Louis—American Asphalt Roof Corp., 31st and Louisville and Ashville tracks, R. P. Munger, Purch. Agt.—engine lathe to turn up to 36 in. and 9 ft. between centers; 1 quick change screw lathe, up to 20 in. swing; one 20 in. back geared drill press; one 2 or 2½ universal miller, etc.

Mich., Detroit—Michigan Smelting & Refining Co., 7885 Joseph Campau Ave.—die casting machinery for proposed extension to plant.

N. Y., Buffalo—Bronze Aluminum Co., 212 Winchester Ave. small tools and equipment for the manufacture of aluminum ware.

N. Y., Buffalo — Fedders Mfg. Co., 21 Tonawanda St.—machinery, tools and equipment for proposed 50 x 255 ft. factory for the manufacture of auto radiators.

N. Y., Buffalo—Packard Motor Co., 1333 Main St.—equipment for auto repair and service station.

O., Cleveland — The Cleveland Punch & Shear Works Co., 3917 St. Clair Ave.—42 in. Bullard vertical lathe.

Pa., Darby—Norbom Engineering Co.—slotter, 18 in. stroke or more, motor driven.

Pa., Pittsburgh—Pittsburgh & Lake Erie R.R. Co., Pittsburgh & Lake Erie Terminal Bldg. C. M. Yoke, Purch. Agt.—one 100 in. boring mill.

Tenn., Tullahoma — Campbell & Dann Mfg. Co.—chain mortiser.

W. Va., Logan—Guyan Machine Shops—6 x 72 in. low swing lathe.

Australia, Melbourne—Victorian Government Railways, will receive bids until March 10 for 1 hydraulic cap riveter complete with all necessary equipment, also until April 7 for 1 hydraulic plate bending press complete with equipment.

Opportunities for Future Business

Ala., Birmingham—G. C. Phillips Tractor Co. has work under way on the construction of a plant for building tractors for road work, also other road building machinery at Seventh St. and Second Ave.

Calif., Los Angeles—Link-Belt, Messe & Gottfried Co., 400 East Third St., has acquired a site and plans the construction of a factory for the manufacture of excavating machinery, sand and gravel washing machinery, chain drives, gas and steam shovels, etc., at First and Anderson Sts. Estimated cost $75,000.

Calif., Stockton—Frazier & Co., c/o R. Morrell, Union Bldg., Archt., is having plans prepared for the construction of a 1 story shop at Church and South San Joaquin Sts., for the manufacture of sheet metal products. Estimated cost $9,500.

Calif., Los Angeles—O. H. Neher, Insurance Exchange Bldg., Archt., soon takes bids for the construction of 1 and 2 story 150 x 210 ft. garage, etc., West Washington St., for M. E. Foy.

Calif., Redwood City — City Trustees, W. A. Price, Clk., soon takes bids for the construction of a 1 story, 25 x 40 ft. machine shop, here.

Calif., Sacramento—White Co., 11th and Mission Sts., San Francisco, awarded contract for the construction of motor truck assembly plant, etc., 13th and C Sts., here. Estimated cost $45,000.

Conn., Danbury—The Schwartz Co., 284 Main St., is receiving bids for the construction of 2 story, 80 x 100 ft., garage and repair station on Main St. Estimated cost $66,000. Private plans.

Conn., New Britain — American Hardware Corp., 10 Franklin Sq., awarded contract for the construction of 2 story, 60 x 360 ft. factory, at plant, here. Estimated cost $160,000. Noted Jan. 28.

Ill., Chicago—H. M. Garriott, Indianapolis, Ind., Archt., will receive bids about Feb. 25 for the construction of a 1 story, 85 x 125 ft. factory for Mid City Auto Body & Wagon Works, 401 North Morgan St., Chicago, Ill. Estimated costa $40,000.

Ill., Chicago — The Hendrickson Motor Truck Co., 3538 South Wabash Ave., awarded contract for the construction of a 1 story, 50 x 175 ft. machine shop. Estimated cost $25,000.

Ill., Chicago—R. E. Major & Co., 4022 West Madison St., Archts., are receiving bids for the construction of a 1 story, 120 x 120 ft. factory for Western Name Plate Co., 4638 West Huron St. Estimated cost $60,000.

Every one of these items is reported by our authorized correspondents who are instructed to verify every item sent in. This free weekly service is published in the interests of the buyer and the seller, to bring them together and get machinery moving.

Everything possible is done to insure authenticity and timeliness.

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BUSINESS NEWS DEPARTMENT
Tenth Ave. at 36th St., New York

Ill., Chicago—Morton Mfg. Co., 5133 West Lake St., awarded general contract for a 2 story, 93 x 228 and 50 x 105 ft. office and factory building for the manufacture of railroad supplies and various specialties for automobiles at 5111 West Lake St. Estimated cost $95,000.

Ill., Chicago — Norton-Loseer Co., 4024 North Rockwell St., hardware specialties, awarded contract for the construction of a 1 story, 108 x 180 ft. factory. Estimated cost $51,000.

Ill., Evanston—Toy Tinkers Co. awarded contract for the construction of a 4 story, 120 x 196 ft. factory at Ridge Ave. and Leon Place. Estimated cost $140,000.

Ill., Moline — Harrington-Seaberg Fire Alarm Telegraph Co., 1708 Third Ave., awarded contract for the construction of a 3 story, 60 x 120 ft. factory on 20th St. Estimated cost $60,000.

Mass., Boston—Y. D. Service Garage, Inc., will build 8 story garage on Park Square. Estimated cost $2,250,000. Krokyor & Browne, 220 Devonshire St., Archts.

N. Y., Brooklyn—S. C. LaVence, Inc., c/o Magnuson & Kleinert, Engr. and Archt., 250 Park Ave., New York City, awarded contract for the construction of a 2 story, 100 x 170 ft. garage, on Bedford Ave. Estimated cost $200,000.

N. Y., Buffalo—N. Mecca, 304 Connecticut St., plans the construction of a 50 x 100 ft. garage and repair shop. Estimated cost $60,000.

N. Y., Olean—Pennsylvania R.R. Co., Broad St. Station, Phila., Pa., awarded contract for the construction of a 1 story, 100 x 175 ft., addition to car shops, here. Estimated cost $250,000. Noted Jan. 14.

O., Cleveland—Crucible Steel Casting Co., W. H. Shepard, pres., West 84th St. and Almira Ave., having preliminary plans prepared for the construction of a 1 story, 100 x 200 ft. foundry, West 84th St. Estimated cost $100,000. G. S. Rider Co., Bldg., Archt.

O., Cleveland—Gluntz Foundry Co., 3005 East 55th St., awarded contract for the construction of a 1 story, 60 x 126 ft. and 24 x 30 ft. addition to foundry. Estimated cost $42,000.

O., Dayton—The Insland Mfg. Co., Coleman St., is having plans prepared for the construction of a 2 story addition to plant for the manufacture of metal products. Frank Hill Smith, Inc., Winters Bldg., Engr.

O., Dayton—The Jones-Nash Co., B. W. Jones, Pres., 307 East 1st St., had plans prepared for the construction of a 2 story, 80 x 210 ft. repair and service garage. Estimated cost including equipment $65,000.. Gebhart & Schaeffer, Keith Bldg., Archts.

O., Youngstown—John H. Fitch Co., F. C. King, pres., 102 Wick Ave., soon awards contract for the construction of a 3 story, 63 x 327 ft., garage. Estimated cost $300,000. Shank & Foster, 6007 Euclid Ave., Cleveland, Structural Engr. M. W. Scheibel, Realty Bldg., Archt. Noted Jan. 28.

Pa., Altoona — Pennsylvania R.R. Co., Broad Street Station, Phila., Pa., awarded contract for the construction 2 story, 35 x 80 ft., scales building. Estimated cost $150,000.

Tenn., Paris — Louisville & Nashville R.R. Co., having plans prepared for the construction of shops and mill, at West Paris to replace those, recently destroyed by fire. W. H. Courteney, Louisville, Ch. Engr.

Wash., Olympia—Bd. of Education will receive bids until March 3 for the construction of a 4 story, 77 x 150 ft. addition to high school including manual training shop, etc., on Washington St. Estimated cost $180,000. J. H. Wohleb, Archt. and Engr.

W. Va., Weirton — Weirton Steel Co., awarded steel contract for the construction of 8 sheet mills, for plant, here. Estimated cost $2,000,000.

Wis., Milwaukee—H. J. Esser, 82 Wisconsin St., Archt., is receiving bids for the construction of a 1 story, 36 x 130 ft. addition to factory for A. B. & B. Sheet Metal Works, 3300 Fond du Lac Ave. Estimated cost $40,000.

Wis., Milwaukee — Ruech Printing Machinery Co., 485 Broadway, is having plans prepared for the construction of a 3 story, 32 x 120 ft. manufacturing plant. Estimated cost $50,000. O. Webb, 544 49th St., Archt.

Man., Winnipeg—International Harvester Co. of Canada, Ltd., 606 South Michigan Ave., Chicago, Ill., J. A. Tanner, Local Mgr., having plans prepared for the construction of 5 story addition to plant, here. Estimated cost $190,000. Private plans.